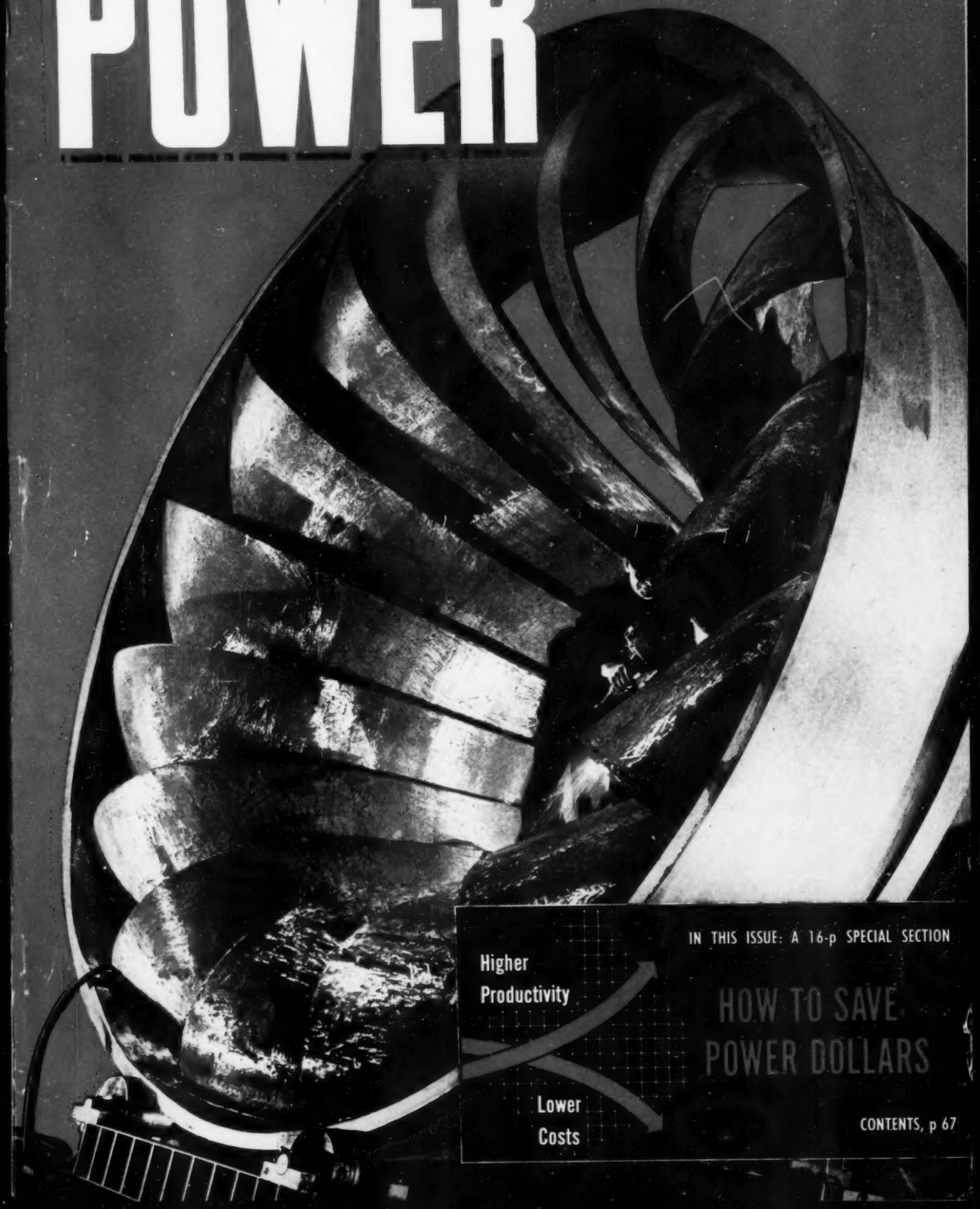
POWER

OCTOBER 1949



IN THIS ISSUE: A 16-p SPECIAL SECTION

Higher Productivity

Lower Costs

HOW TO SAVE POWER DOLLARS

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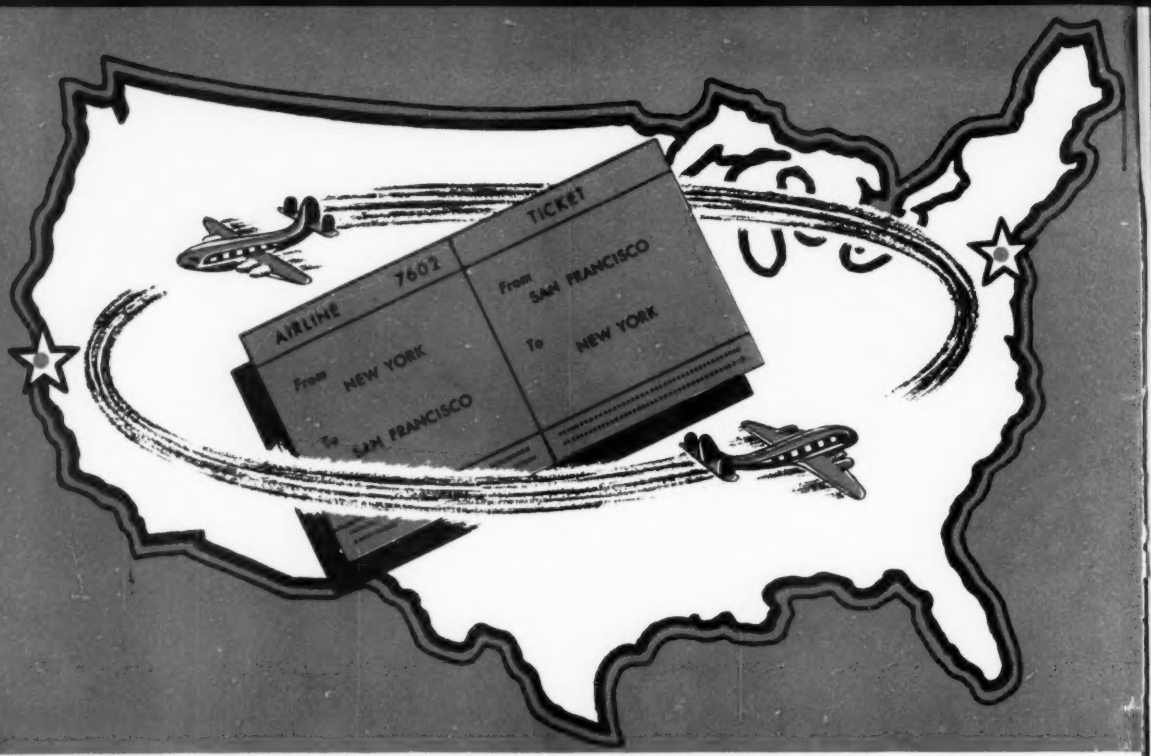


WATER, too, gets "ROUND-TRIP" SAVINGS in modern ash and dust handling

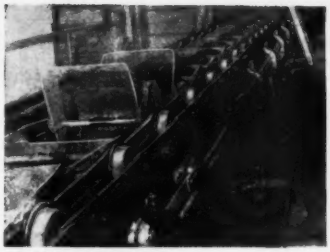
In flying across the country and back, you would naturally buy a round-trip ticket and benefit by its savings. In modern ash and dust handling, you can reap the same round-trip benefits by using Recirculating Hydrojet and Hydrovac Systems in which water is responsible for "round-trip" savings, i. e., it is used over and over again. This is important where water is scarce and/or costly. No water goes to sewer or waste and only a small amount of make-up is needed to compensate for absorption by ash and mixture with dust, when unloaded in cars or trucks. Our nearest representative can tell you the advantages of "round-trip" water savings in Recirculating Hydrojet and Hydrovac for your present power plant or the one you're planning. Write us.

HYDROJET *and* HYDROVAC

ALLEN-SHERMAN-HOFF CO., 227 S. 15th ST., PHILADELPHIA 2, PA. ***Offices & Representatives in Principal Cities***

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," "The Stationary Engineer), October, 1949, Vol. 93, No. 10 Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 W. 42nd St., New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least 10 days for change of address. Subscription rates, U. S. and U. S. possessions, $5 for one year, $7 for two years, 50c per single copy. Canada, $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $23 for two years. Please indicate position and company connection on all subscription orders.

LINK-BELT
COAL & ASHES HANDLING MACHINERY

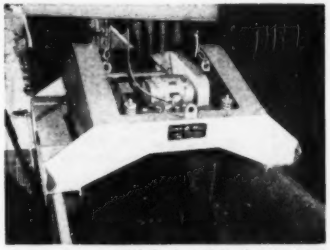


PECK CARRIER

An overlapping type pivoted bucket carrier for handling both coal and ashes in one unit.

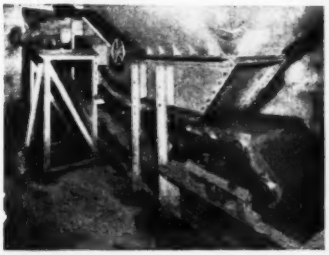
STACKERS

A type and size for any storage capacity.



CAR SHAKERS & UNLOADERS

A type and size for the rapid and economical unloading of coal or similar materials from hopper bottom cars.



FEEDERS

Available in apron, chain, bar, belt, oscillating, reciprocating, screw and vibrating types for coal and other materials.

Link-Belt Standard Units plus specialized "know-how" for integrating them into operations for high efficiency, high production and low operating costs, are backed by more than 70 years of experience.

We welcome the opportunity to serve you. Catalogs on any product will be sent on request.

Other Link-Belt products, not illustrated, include Bulk-Flo Elevator-Conveyor-Feeders . . . Coal Crushers . . . Rotary Car Dumpers . . . Weigh Larries . . . Unloading Towers . . . Silo Systems . . . Bunkers . . . Gates . . . Hoppers . . . Traveling Water Intake Screens . . . Ball, Roller and Babbitted Bearing Pillow Blocks . . . Clutches . . . V-Belt Drives . . . Shaft Couplings, etc.

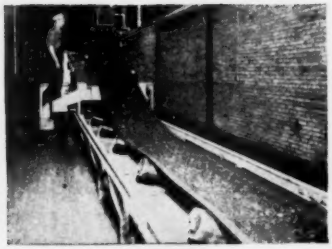
11,555

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Houston 3, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

SKIP HOISTS

For all capacities and lifts, elevating coal, coke, ashes, etc., at low cost.

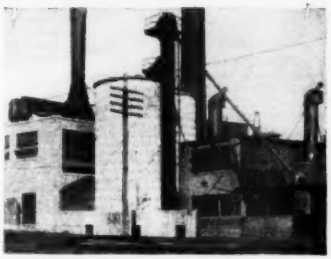


BELT CONVEYORS

The reliable and flexible conveyor for handling large capacities at greatest economy.

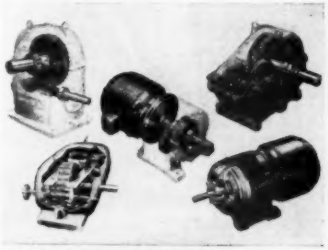
YARD STORAGE

Various storage and reclaiming systems have been designed for efficient and low cost operation.



BUCKET ELEVATORS

Available in a number of standard types to meet your particular condition.



ENCLOSED DRIVES

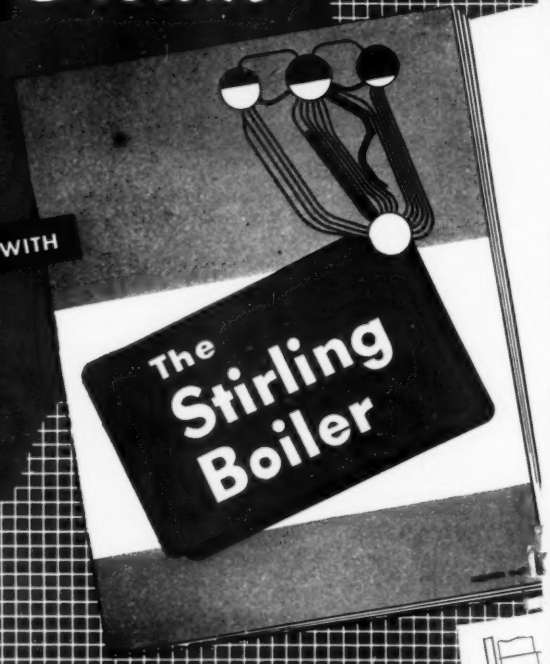
Gear Drives, Gearmotors, Fluid Drives, Variable Speed Drives, Chain Drives, etc. for the efficient transmission of power.

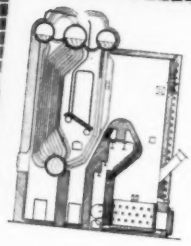
Modern LOW COST *Steam*

FOR THESE INDUSTRIES:

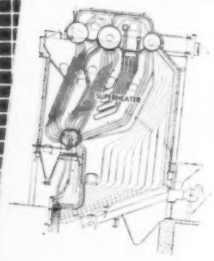
FOOD
DRUGS
STEEL
CHEMICALS
PETROLEUM
SUGAR
LUMBER
MINING
PAPER
LEATHER
CEMENT
TEXTILES
TOBACCO
MANUFACTURING
AUTOMOTIVE
RAILROADS
HEATING AND
AIR CONDITIONING
POWER
GAS
BEVERAGES
PLASTICS
RUBBER
AIRCRAFT

WITH



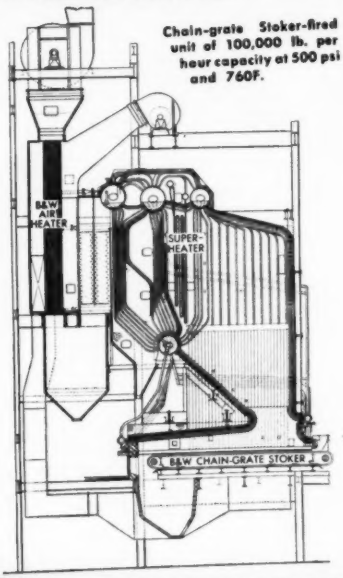


Bagasse-fired Stirling Boiler with Ward single-pass waste-fuel furnace.



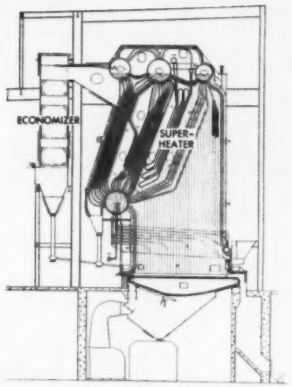
Underfeed Stoker-fired installation with steam capacity of 35,000 lb. per hour at 425 psi and 750F.

Chain-grate Stoker-fired unit of 100,000 lb. per hour capacity at 500 psi and 760F.



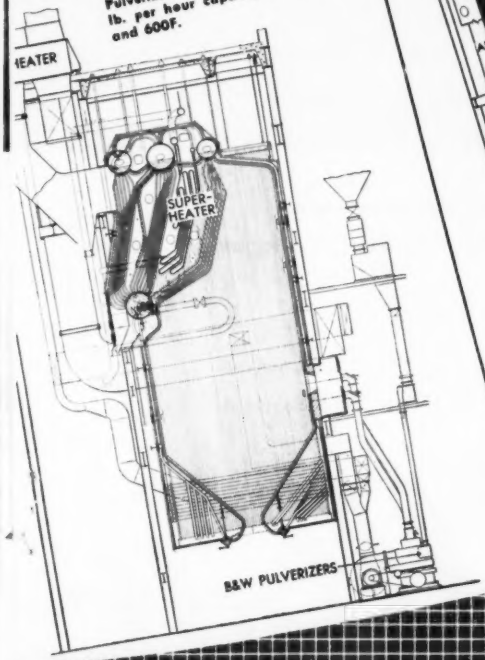
Over 46,000,000 lb. per hr. of new steam capacity is being provided for these industries, and many non-industrial power plants, by Stirling boilers ordered during the past four years. These new units span a capacity range of 5,000 to 500,000 lb per hr. at design pressures up to 1060 psi, and temperatures up to 950F.

Adaptable to a wide variety of furnace types with any degree of water-cooling, and to any fuel and firing method, the Stirling boiler reliably delivers clean, dry steam even with relatively high boiler water concentrations . . . readily responds to sudden and heavy load swings. These are some of the reasons why Stirling boilers have been a heavy favorite for 61 years with users of power, heating, and process steam . . . reasons why continued preference is shown for the modern versions of this service-proved design. A complete account of the Stirling's many advantages is contained in Bulletin G-62. Write the Babcock & Wilcox Co., 85 Liberty St., New York 6, N. Y.

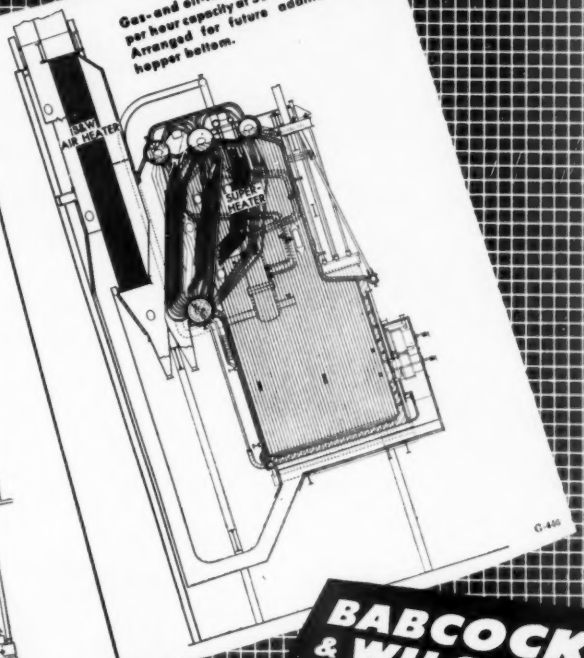


Spreader stoker-fired unit rated at 125,000 lb. per hour at 300 psi and 650F.

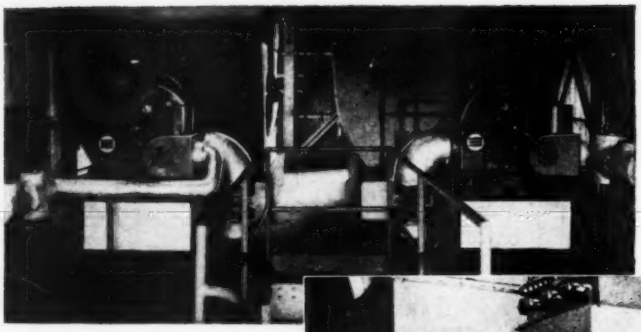
Pulverized coal-fired unit of 300,000 lb. per hour capacity at 336 psi and 600F.



Gas- and oil-fired unit of 375,000 lb. per hour capacity at 500 psi and 725F. Arranged for future addition of a hopper bottom.



BABCOCK & WILCOX



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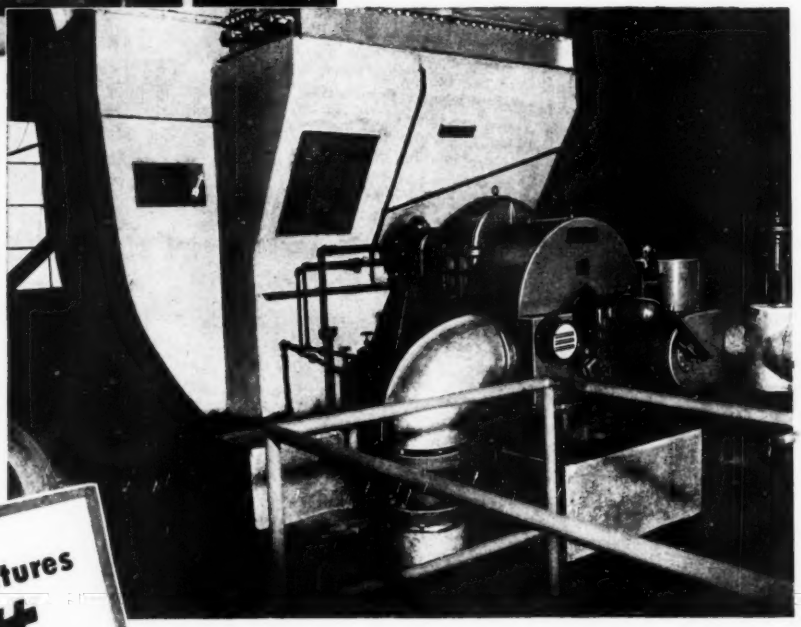


Exceptional features of Elliott MECHANICAL DRIVE TURBINES

- True centerline supports
- Readily removable packing cases
- Sealed bearings
- Sealed governor
- Balanced double-seated valves
- Economical liner type bearings

Elliott

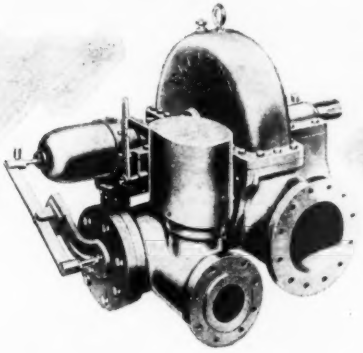
standardized *yet broadly adaptable*

ELLIOTT MECHANICAL DRIVE TURBINES

The new YR line of turbines, while highly standardized for normal applications, is available with standardized modifications for special applications. The normal wearing parts are interchangeable in all cases, minimizing maintenance costs.

In the installation shown here, two standard YR turbines are fitted with built-in gears to make a compact, neat, and workmanlike installation. They are driving induced draft fans in a new boiler plant of a large chemical manufacturing plant.

Along with their exceptional adaptability Elliott YR turbines maintain the tradition of Elliott simplicity and dependability. As one plant engineer said recently to another engineer who had been having drive troubles, "Why don't you put in Elliott turbines and stop worrying?"



H-724

COMPANY

STEAM TURBINE DEPT., JEANNETTE, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.

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STEAM TURBINES • GAS TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • EXPANDERS • FILTERS

CLEANER

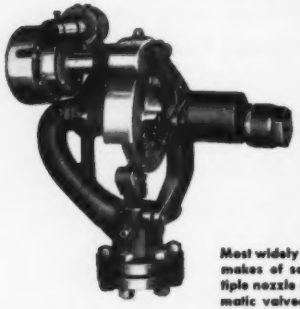
During 45 years of supplying most* of the soot blowers used in utility and industrial power plants, the Diamond Power Specialty Corporation has developed individual blowers for every soot cleaning requirement.

As a result, no matter what sort of blowing job you have, there is a Diamond Blower to fit it exactly. If you specify Diamond Blowers, there is no need to compromise . . . no need to use soot blowers that are inefficient for the particular job at hand.

Many more* installations means much more experience . . . consequently our engineers have acquired exceptional skill in the application of soot blowers. They know how to recommend blowers that result in cleaner boilers.

Some of the Diamond Blowers available are illustrated here . . . others are shown in Diamond Catalog No. 1014. May we send you a copy?

For decades Diamond has sold approximately 80% of all soot blowers for power boilers.

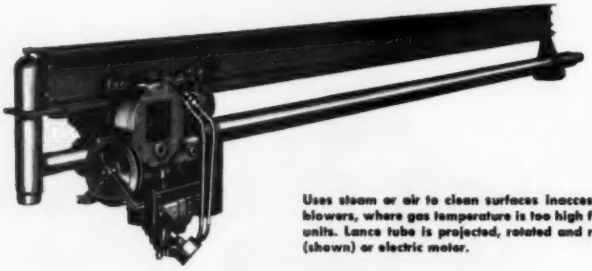


DIAMOND
Model G9B
Soot Blower

Most widely used of all types and makes of soot blowers. A multiple nozzle steam blower. Automatic valved . . . goes through complete operating cycle as the single chain is pulled or when driven by air (shown) or electric motor. Cam and trigger operation, flexible element connection and adjustable pressure control are important features.

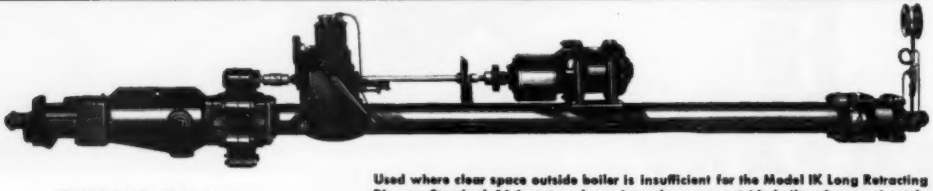
DIAMOND
Model IS Short
Retracting
Soot Blower

Uses either air or steam as cleaning medium. For cleaning furnace walls or boiler heating surface in hot locations. Positive poppet type valve prevents leakage and flow until nozzle is in blowing position; lubrication unnecessary; adjustable pressure control; few working parts. Operation is air (shown), manual, or electric.



DIAMOND
Model IK
Long Retracting
Soot Blower

Uses steam or air to clean surfaces inaccessible to short retracting blowers, where gas temperature is too high for permanently installed units. Lance tube is projected, rotated and retracted by a single air (shown) or electric motor.

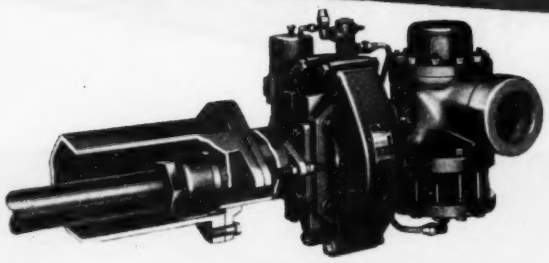


DIAMOND Telescopic
Long Retracting Soot Blower

Used where clear space outside boiler is insufficient for the Model IK Long Retracting Blower. Standard 16-foot travel requires clearance outside boiler of approximately 12 feet. Built special for maximum travel of 20 feet with outside clearance requirement of about 14 feet. Special shorter models also available. Air or electric (shown) operation . . . uses steam or air as cleaning medium.

BOILERS

Because there is a DIAMOND SOOT BLOWER for Every Condition



DIAMOND
Model A2E
Automatic Air Puff
Soot Blower

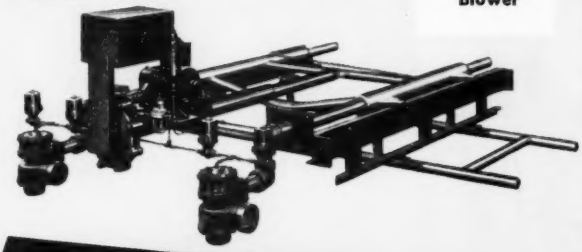
Cleans automatically with series of compressed air puffs delivered through a standard multiple nozzle blowing element. During puff the element is automatically rotated through a small arc; sufficient puffs are automatically provided to complete blowing arc. Spreading cleaning over longer period permits use of much smaller compressor and receiver—expels soot in small quantities—eliminates upset operating conditions.

DIAMOND
Air Puff
Master
Controller

Automatically controls all A2E units to which it is connected. The operator opens one valve (either manual or automatic) . . . the controller does the rest . . . controls puff duration and interval, regulates element rotation, opens and closes air valve in head, determines sequence.

One or more multiple nozzle elements mounted on traveling frame. Elements traverse a straight line across tube sheet. Blowing medium is compressed air discharged intermittently and only when in register with tubes to reduce compressor and tank size. Air or electric operation—air or electric control, completely automatic.

DIAMOND
Automatic
Air Heater
Blower

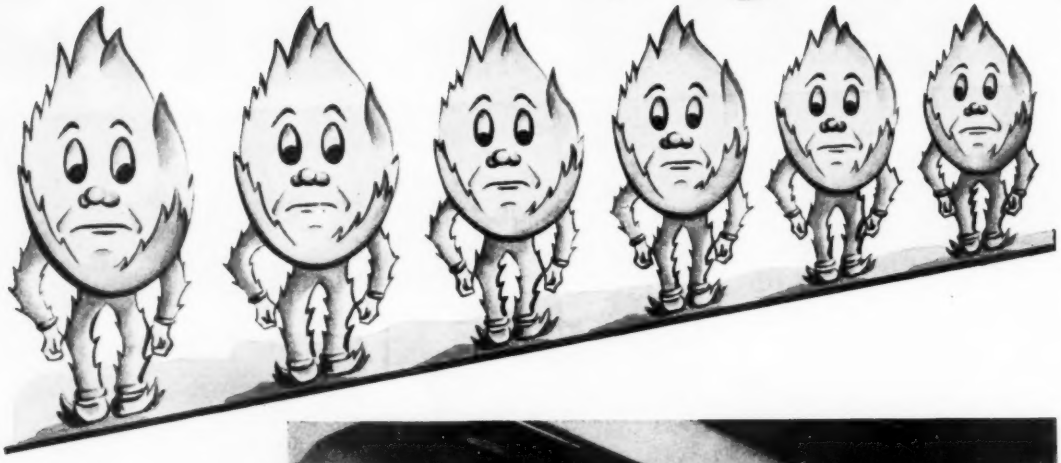


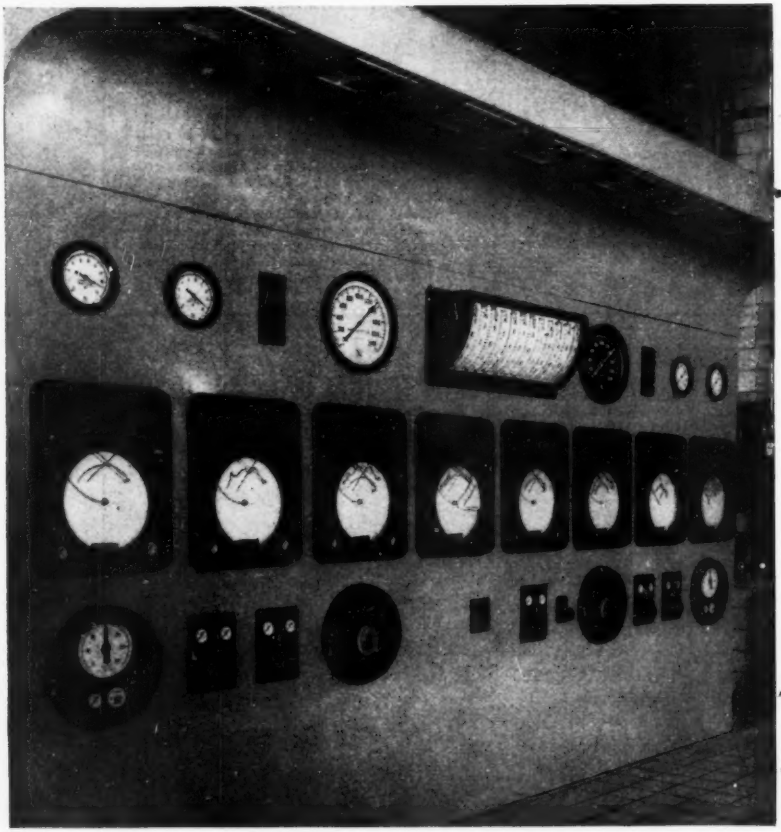
DIAMOND
Air Control
Panel

Controls automatic cleaning cycle of any arrangement of the various types of blowers. Operator starts cycle simply by moving start and stop valve carrier to the down position. Traveling upward it operates each selected unit or group in turn; shuts off when all cleaning cycles are completed. Shows at a glance the unit in operation and those that have operated. No electrical connections whatever.

DIAMOND POWER SPECIALTY CORP.
DETROIT 31, MICHIGAN
Diamond Specialty Limited • Windsor, Ontario

Keeping Btu's



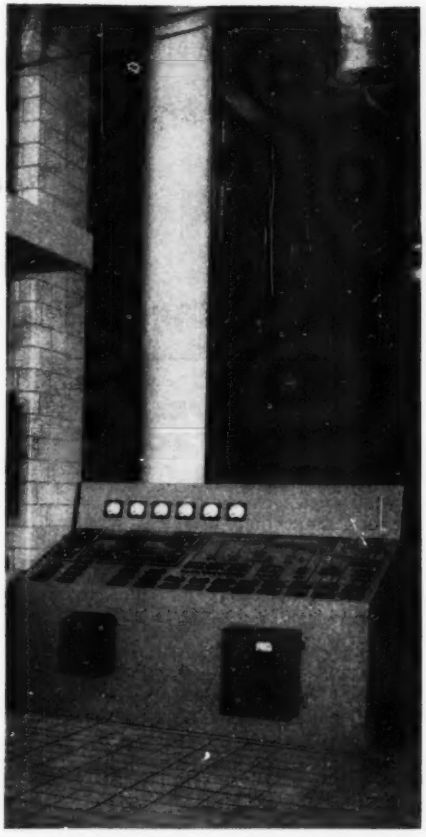


Bailey Boiler Control Panels for 200,000 lb per hour capacity, 880 psi, 900° F pulverized coal-fired boiler at the Hudson Steam Plant of Rockland Light and Power Company, Tomkins Cove, New York. All

Branches in: Atlanta, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Denver, Detroit, Houston, Kansas City, Los Angeles,

IN LINE

at Tomkins Cove



Boiler Controls are co-ordinated to insure efficient handling of the heat energy released in combustion.

● Optimum conditions in routine operation are provided for at the Hudson Steam Plant of Rockland Light and Power Company. This new station at Tomkins Cove, New York, keeps Btu's in line with a complete installation of Bailey Boiler Controls, all co-ordinated to work as a team in directing the efficient use of heat energy.

The installation includes:

Bailey Combustion Control

Bailey Three-element Feed Water Control

Bailey Steam Temperature Control

Bailey Coal-Air Temperature Control

Bailey Three-element Condensate Control.

It's easy to keep Btu's in line with co-ordinated controls engineered to fit your plant.

Call your local Bailey Engineer for recommendations on how meters and controls can help you to get more useable heat energy from your fuels.

A-108-2

BAILEY METER COMPANY

1036 IVANHOE ROAD · CLEVELAND 10, OHIO

BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

BAILEY METERS

Controls for Steam Plants

COMBUSTION · FEED WATER · TEMPERATURE

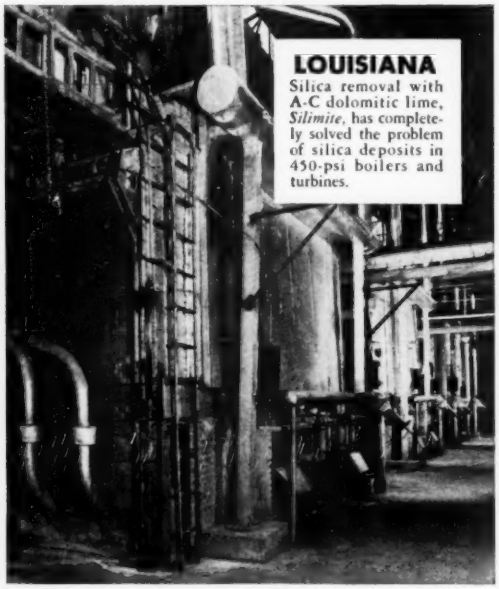
PRESSURE · LIQUID LEVEL · FEED PUMPS

Milwaukee, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, San Francisco, Schenectady, Seattle

37 Paper Mills

with Allis-Chalmers Water Conditioning

ILLINOIS
Plant operator making boiler water control test for 150-psi units. Feed-water is furnished by A-C 4280 gph hot process softener.



LOUISIANA
Silica removal with A-C dolomitic lime, *Silimite*, has completely solved the problem of silica deposits in 450-psi boilers and turbines.

EXPERIENCE OF PAPER MILLS ACROSS U. S. IS TYPICAL OF ALLIS-CHALMERS AID TO ALL INDUSTRIES FACING WATER PROBLEMS IN STEAM OR POWER GENERATION

WHEREVER WATER IS HARD, high in silica, or contains objectionable material, Allis-Chalmers provides proper treatment to avoid costly damage to boilers, superheaters, turbines and process equipment. That's why these and many other paper mills are finding A-C's 3-way program of Service, Chemicals and Equipment their best means of solving water conditioning problems.

Save Time Trouble, Money, with 3-Way Program!

1. SERVICE

Prompt, regular, personal service calls are the backbone of the A-C program! 1) Survey of plant, securing samples of water from all parts of system. 2) Complete analysis by A-C research lab to provide bases for recommendations. 3) Subsequent checks on procedure, control limits, feeding of chemicals, and factors affecting plant operation.

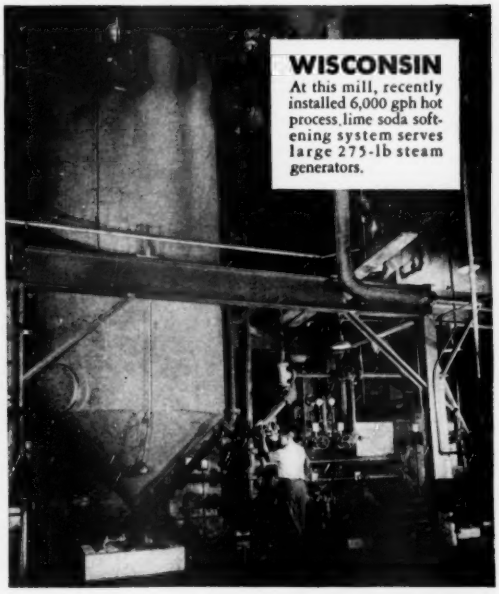
2. CHEMICALS

Properly selected chemicals, correctly applied, assure peak efficiency. A-C engineers give you sound advice on where and how these chemicals can be best used. Formulations include scale inhibitors for all heat exchange cycles . . . special chemicals to prevent boiler scale, control corrosion, reduce silica, and correctly condition sludge.

Get Top Results

Service, Chemicals, Equipment

MICHIGAN
This mill features a newly installed 343,000 gal sodium-hydrogen zeolite combination for feeding 415-psi boilers.



WISCONSIN
At this mill, recently installed 6,000 gph hot process lime soda softening system serves large 275-lb steam generators.

Whatever the industry — paper, petroleum, food, steel — you'll get prompt, convincing results with Allis-Chalmers competent service. Remember, your A-C engineer is prepared to share his experience with you by recommending proper chemicals or helping select the right process for your requirements on the basis of space, cost, and character of raw water. For further information, call your nearest Allis-Chalmers office or write direct.

Silimite is an Allis-Chalmers trademark.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

3. EQUIPMENT

Correct selection of equipment calls for judgment based on experience. From chemical feeder to filter, A-C units are engineered for high treating capacity, built solidly for best operation. Secure your equipment from A-C's line of hot and cold process softeners, sodium and hydrogen zeolites, deionizers, chemical proportioners, filtration systems.

WATER TREATMENT PROBLEM? SEND COUPON TODAY

ALLIS-CHALMERS, 952A SO. 70 ST.
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Position..... Address.....

City..... State.....

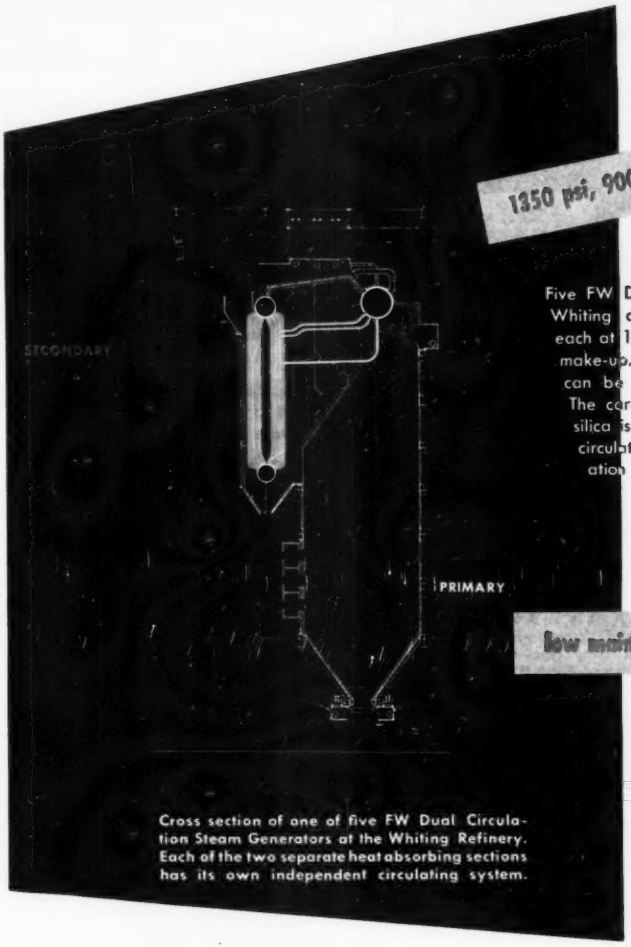
A-2756

More power per lb of process steam

Foster Wheeler Dual Circulation Steam Generators at Whiting Refinery of the Standard Oil Company (Indiana) help achieve this goal

During the ninety years since the world's first oil well was drilled on the banks of Oil Creek, near Titusville, Pa., petroleum processing has evolved into an advanced science. Many new processes, resulting from continued achievements in refining practices, are being made commercially possible because petroleum engineers are alert to techniques for in-

1350 psi, 900 F operation with 100% make-up



Cross section of one of five FW Dual Circulation Steam Generators at the Whiting Refinery. Each of the two separate heat absorbing sections has its own independent circulating system.

Five FW Dual Circulation Steam Generators at Whiting deliver 300,000 lb of steam per hr each at 1350 psi, 900 F operation with 100% make-up. Because of the unique design, steam can be generated with minimum blowdown. The carryover of both solids and vaporized silica is substantially below that of standard circulation units. This assures trouble-free operation at high pressures and temperatures.

low maintenance—high turbine availability

Expensive outages for removal of silica and other deposits from turbine blades are prevented.

creased economy in refinery operations. The FW Dual Circulation Steam Generator is an important development in the interest of economy and helps reduce the cost of power and process steam production.

FOSTER WHEELER CORPORATION
165 Broadway • New York 6, N.Y.

FOSTER WHEELER

"Don't send a boy to do a man's work"

There's a Powell Valve* that's just *right* for every known FLOW CONTROL SERVICE

Most valve failures are the result of misapplication . . . installing valves that aren't of the right design or sturdy enough to do the job for which they are selected. In other words, it's like "sending a boy to do a man's work."

On the other hand, it's a waste of money to specify costly valves for services where less expensive ones may be used. This amounts to putting a man on a job that a boy can do.

To avoid misapplication: (1) standardize on Powell Valves; (2) consult Powell Engineers as to which valves are specifically adapted to each and every one of your individual flow control requirements.

Powell makes such a *complete* Line* that there is a Powell Valve *exactly* suited to every existing service, from the simplest to the most specialized or exacting.

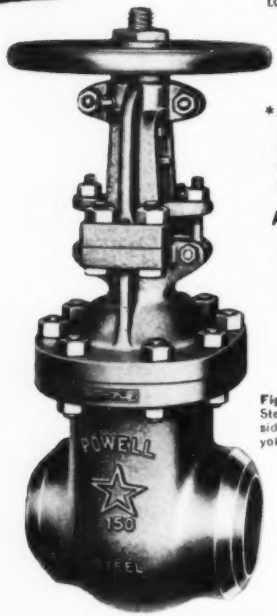


Fig. 1503 W. E. — Class 150-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

*** Powell Valves are made in Bronze, Iron, Steel and a wide selection of Corrosion-Resistant metals and alloys. Valves of every type—Globe, Angle, Gate, Check, Non-return and Flush Bottom Tank Valves—are included in the Complete Powell Line.**

Ask your nearest Distributor—or write direct

The Wm. Powell Company
Cincinnati 22, Ohio
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

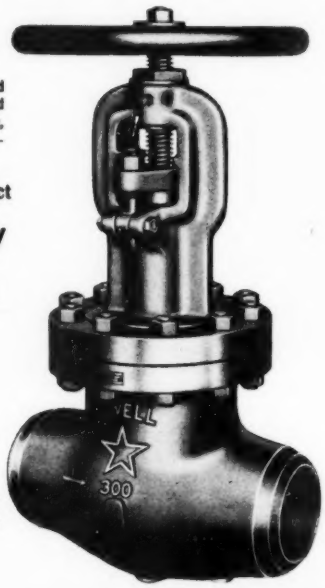


Fig. 3031 W. E. — Class 300-pound Cast Steel Globe Valve with welding ends, outside screw rising stem and bolted flanged yoke.

POWELL

Only POWELL *Pressure Seal* VALVES

have these *Advanced* Features

Added to the many proven advantages offered by Pressure Seal construction, Powell Valves include these exclusive features.

New . . . Improved Pressure Seal Gasket. . . . . .

New . . . Hardened Steel Ring on Top of Gasket . .

New . . . Readily Removable Segmental Thrust Ring

New . . . Lifting Lugs on Yoke Arms. . . . . .

Fig. 11365 W.E.—Class 1500-pound Cast Steel Pressure Seal, Piston - guided, Horizontal Lift Check Valve, with welding ends. Streamline design permits maximum flow through valve with minimum pressure drop.

Available in GATE, NON-RETURN, CHECK, GLOBE and ANGLE patterns

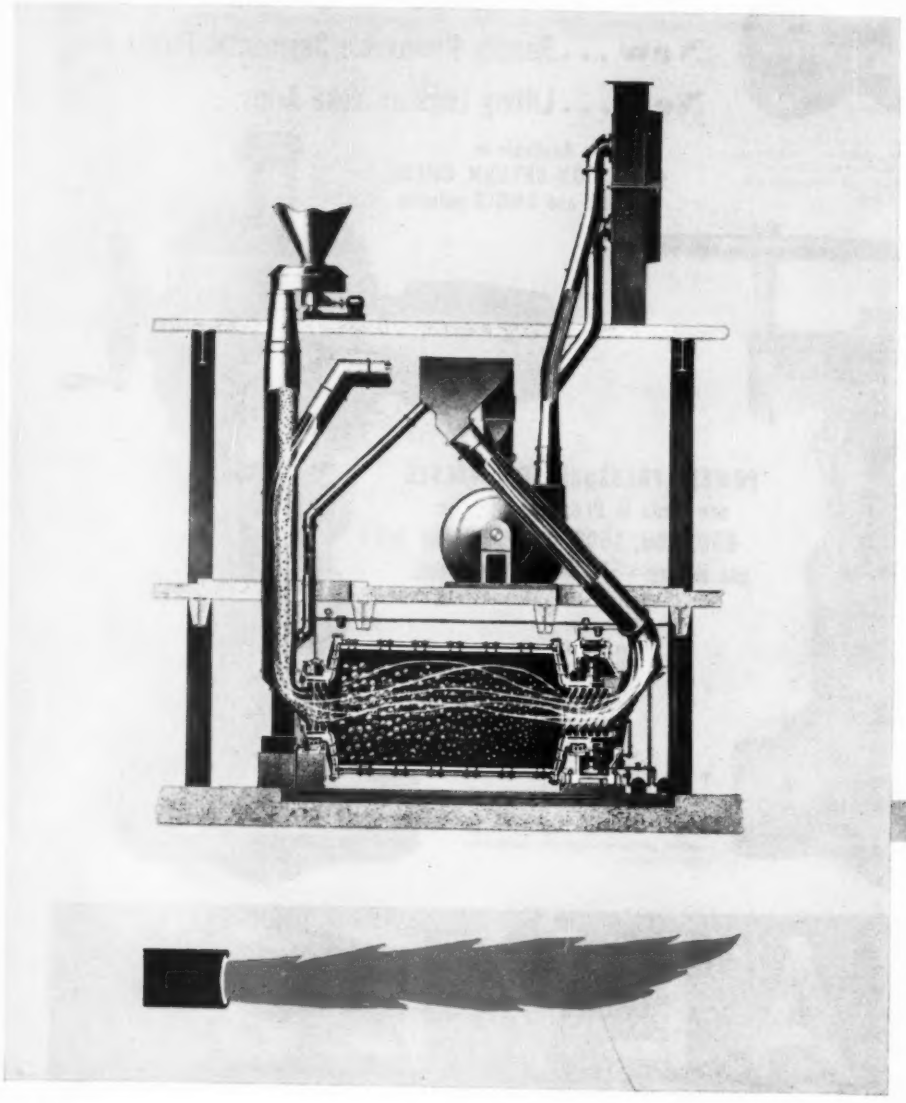
POWELL PRESSURE SEAL VALVES are made in Pressure Classes: 600, 900, 1500, 2500 Pounds and Higher—all Commercial Sizes.

Fig. 11323 W. E.—Class 1500-pound Cast Steel Pressure Seal Gate Valve with welding ends. Has top-mounted electric motor operator for quick, positive opening and closing by remote control.

Fig. 19084 W.E.—Class 900-pound Cast Steel Pressure Seal Globe Non-return Valve with welding ends and spur gear operation. Improved streamline design reduces pressure drop and turbulence to the minimum.

VALVES

Air Swept KVS MILLS...



for Pulverizing Coal at Lower Cost

Single mill capacities from 1200 to 70,000 lb. per hr.
85% through 200 mesh—any coal

Rating changes automatically from minimum to maximum according to demand. Full capacity is instantly available.

Fluctuating loads do not add to your coal bill.

Burn your coal like gas. Unburned carbon in furnace is less than ½%.

Cheaper grades of coal can be purchased for KVS Pulverizers. Greater coal value and better performance are assured.

KVS ENGINEERING SERVICE

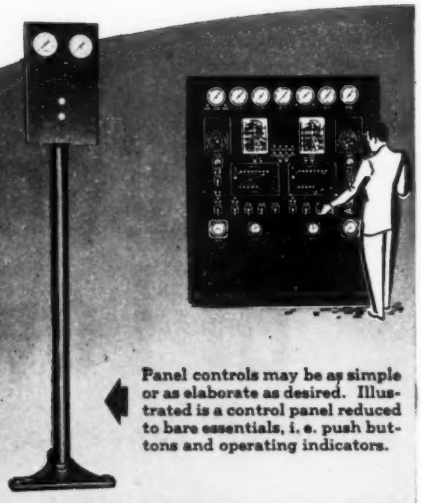
KVS offers a complete service in design, building and erecting complete steam generating plants under one responsibility. KVS engineers are available for consultation on your requirements.

Ask for a copy of 97-page Engineering Bulletin No. 44-B, containing valuable information on preparation of pulverized fuel and steam generating plants.

Kennedy Products — Quality · Kennedy-Van Saun · Service — New York U.S.A. — Mfg. & Eng. Corp.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION



Panel controls may be as simple or as elaborate as desired. Illustrated is a control panel reduced to bare essentials, i. e. push buttons and operating indicators.

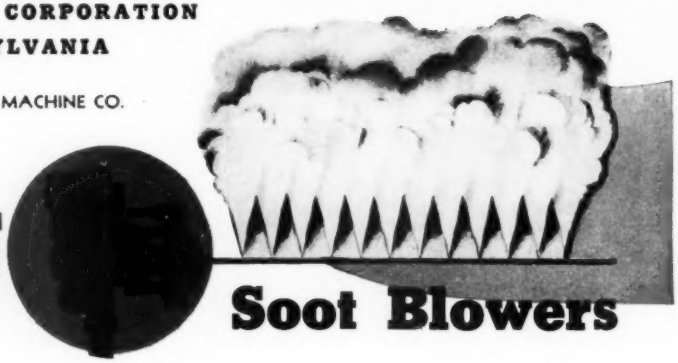
Repeat orders are

6	orders
5	orders
3	orders
3	orders
3	orders
2	orders
2	orders
3	orders

VULCAN Automatic and Automatic Sequential Soot Blowing Systems have become an integral part of hundreds of panel controlled boilers. Their unusual design and flexibility is described and illustrated in a new comprehensive catalog which is available. Send for a copy —see how one-man control systems clean more thoroughly and economically with either air or steam.

VULCAN SOOT BLOWER CORPORATION
DUBOIS, PENNSYLVANIA

Division of
CONTINENTAL FOUNDRY & MACHINE CO.



VULCAN
STEAM OR AIR
Soot Blowers

Panel controls may be as simple or as elaborate as desired. Illustrated is a control panel which incorporates flow meters, operating lights, illuminated boiler diagram, and many other features in addition to push buttons.

Vulcan T-2 Long Retractable Blower with revolving lance fully extended. These blowers are built for travels up to 25 feet and are push button controlled at the unit as well as at the central control panel. Bulletin 474

Vulcan T-2 Long Retractable Blower with revolving lance retracted and protected while not in action.

Vulcan RW1 Gun Type Blower and Deslagger for Automatic Push Button operation. Effective cleaning, ease of operation and minimum maintenance are their outstanding features. 12" or 24" travels are available. Bulletin 471

"Proof of the Pudding"

- Consolidated Edison Co. of N. Y.
- Philadelphia Electric Co.
- Chicago District Electric Generating Co.
- Long Island Lighting Co.
- Rochester Gas and Electric Co.
- Metropolitan Edison Co.
- Staten Island Edison Co.
- Pennsylvania Electric Co.

Vulcan HG1 Gun Type Blower and Deslagger, similar to the RW1 but designed for manual operation. Bulletin 471.

Vulcomatic Rotary Head Model E-3 used with Automatic Sequential Systems for fixed position rotary elements. Bulletin No. 482

Vulcan Rotary Head Model LG3 similar to Model E-3 but designed for manual operation. Bulletin 481

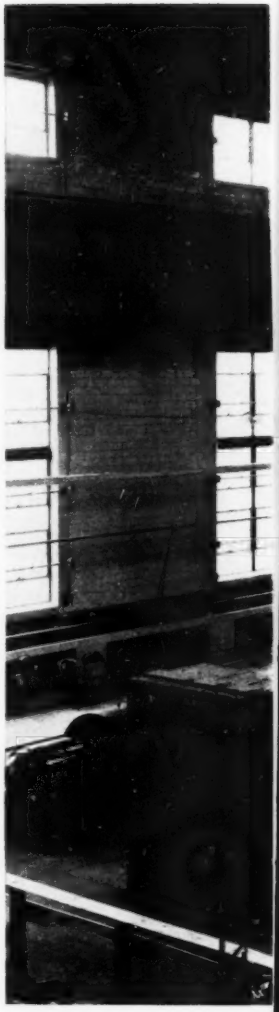
Young turbine with

OFFICIALS of a midwest power company have every reason to believe that their new 40,000-KW turbine, shown above, will never have to be shut down for oil replacement, oil system cleaning, or because of oil acidity troubles. Their convictions are based on their own experience with Nonpareil Turbine Oil.

Since 1940, this company has put Nonpareil Turbine Oil into five big turbines, including the new unit. These five turbines have a total capacity of 188,500 KW. During the *one to nine years of operation* on Nonpareil, neutralization numbers have stayed below .06 mg. KOH/gm. There have been no time losses or troubles caused by high acidity. Oil systems have not required cleaning. Such benefits are assured this company, not only for 8 or 10 years, but for the *life* of its turbines. This assurance is based on Nonpareil's written guarantee that it will maintain a neutralization number below 0.15 mg. KOH/gm.

Why not end oil system maintenance and oil acidity troubles, once and for all, by using Nonpareil Turbine Oil in your turbines? For more evidence of these savings, ask a Standard Oil Lubrication Engineer to supply you data from 20-year service records of Nonpareil Turbine Oil.

Write Standard Oil Company (Ind.), 910 S. Michigan Ave., Chicago 80, Ill.



NONPAREIL
Turbine Oil

"Will outlast your turbine"

STANDARD **STANDARD OIL COMPANY (INDIANA)**

a bright future...

STANDARD OIL COMPANY (INDIANA)

STANDARD

Acceptance the Real Test of a successful development

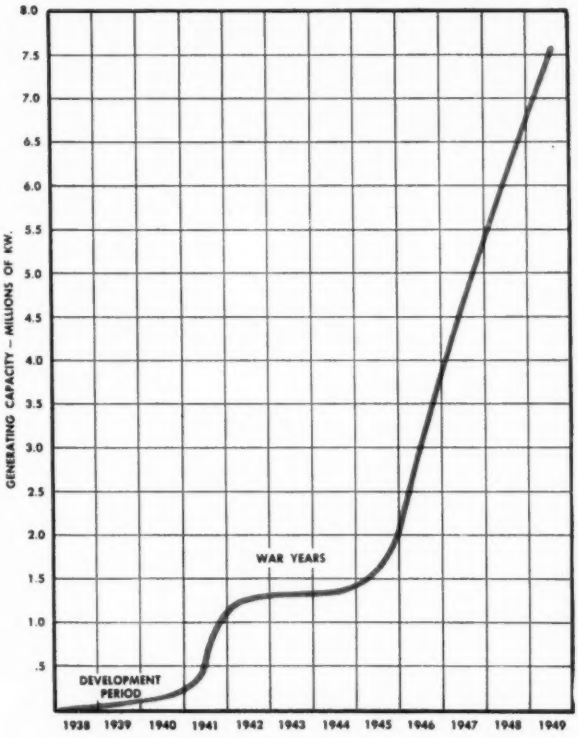
The enthusiastic acceptance by the electric utility companies of the Vertically-adjustable Burner—major adjunct to Combustion's long established tangential method of firing—is graphically expressed on the accompanying chart. It tells the story more clearly perhaps than mere words can.

Introduced initially in 1938, this burner—it's more than a burner, it's a method of firing—went through a brief development period, was successfully applied in several plants, and then ran into war restrictions which precluded utility station expansion. Nevertheless, the die was cast, and when a tremendous postwar utility expansion program got under way in 1945, the Vertically-adjustable, Tangential Burner—the Tilting Burner, if you will—zoomed to immediate success.

Since the war's end electric utilities have installed or ordered C-E pulverized coal fired units with an aggregate capacity in excess of **64,000,000 lb** of steam per hr, **88%** of which is equipped with Vertically-adjustable, Tangential Burners . . . well over **1,000,000 KW** a year is the postwar average capacity of the units equipped with "Tilting Burners."

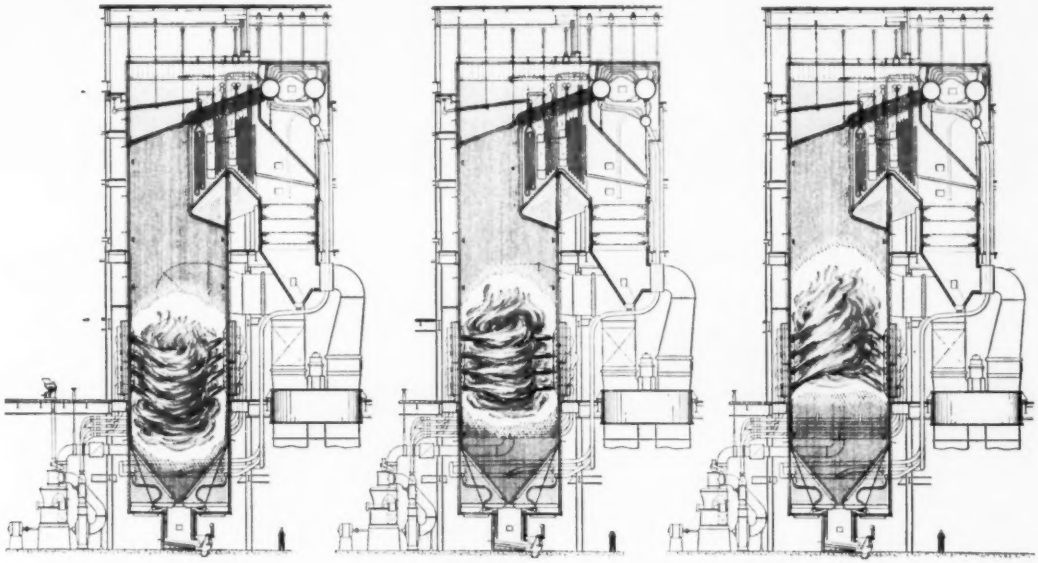
No other burner—no modern method of firing pulverized coal—can point to any such record of buyer acceptance.

The diagrammatic representation of the "Tilting Burner" and resumé of its principal advantages, given on the opposite page, will assist in understanding the reasons for its success. B-345



COMBUSTION ENGINEERING

A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY



Advantages of the Tilting Burner

The combination of tangential firing and the Vertically-adjustable Burner accomplishes certain highly important results beyond the reach of any other burner or firing method presently available. These are:

1. Control of the temperature of furnace gases at the furnace exit which permits:

- ***(a) Control of superheat temperatures over a wide range.***
- ***(b) Minimum use of desuperheating spray.***
- ***(c) Use of wide variety of coals.***
- ***(d) Accurate proportioning of superheater and reheater surfaces.***
- ***(e) Lower air heater maintenance.***

2. Substantial control over slagging conditions which results in:

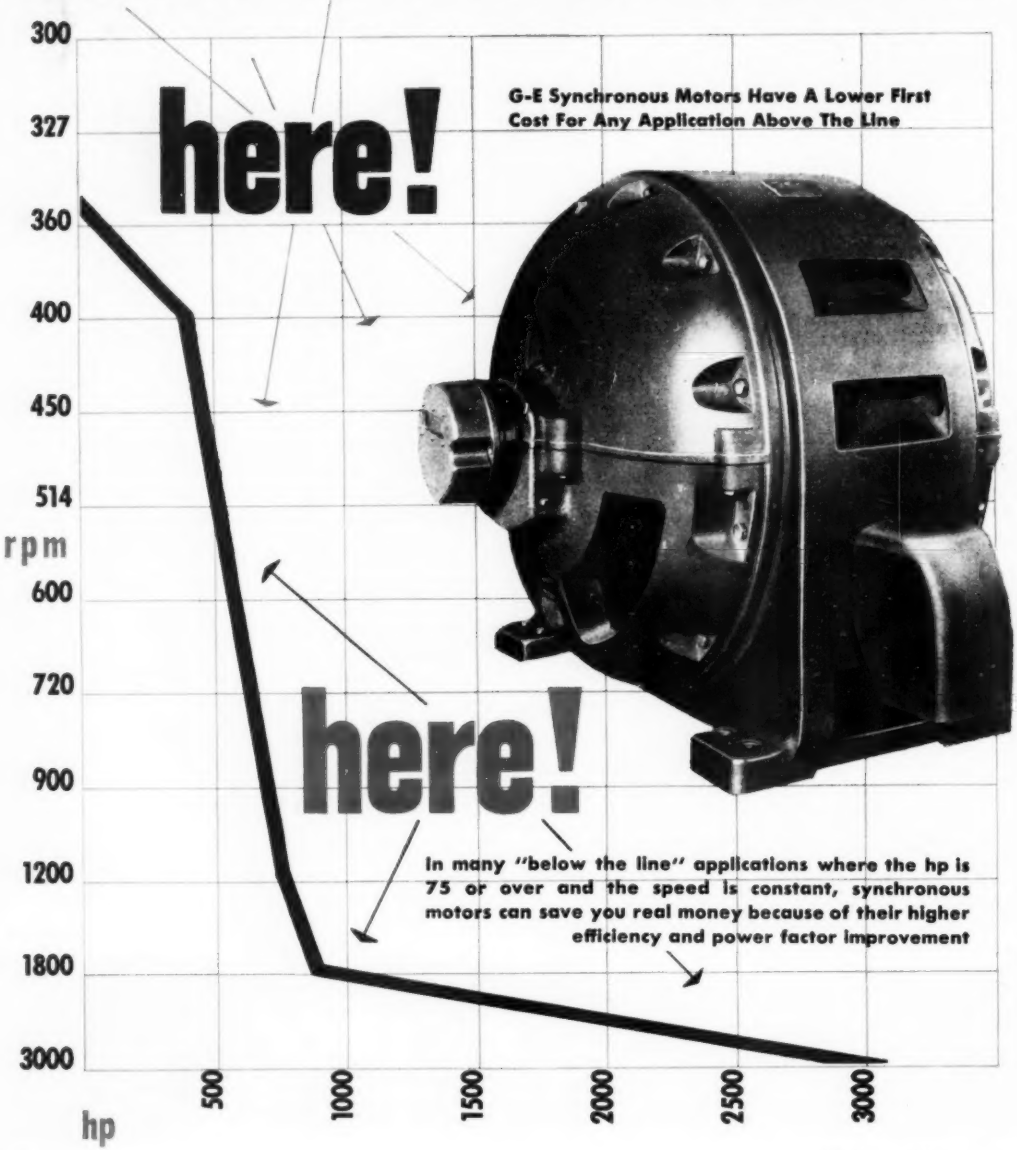
- ***(a) More uniform furnace conditions.***
- ***(b) Better heat absorption.***
- ***(c) Minimum use of soot blowers.***

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

SAVE MONEY!


300
327
360
400
450
514
rpm
600
720
900
1200
1800
3000
500
1000
1500
2000
2500
3000
hp
here!
G-E Synchronous Motors Have A Lower First Cost For Any Application Above The Line
here!
In many "below the line" applications where the hp is 75 or over and the speed is constant, synchronous motors can save you real money because of their higher efficiency and power factor improvement

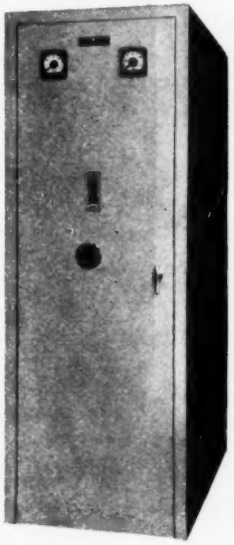
USE GENERAL ELECTRIC SYNCHRONOUS MOTORS

In their natural fields of application, synchronous motors have a *lower first cost* than any other kind of motor!

When you specify General Electric synchronous motors, you get unequalled application engineering by experts in the electrical problems of your industry. They make sure you get the right motor—the motor that will give you the greatest return on your investment.

For your next large, constant speed motor, ask your General Electric sales representative for the full story, and how you can take full advantage of the money saving features of G-E synchronous motors.

GET THE MOST FROM YOUR MOTOR WITH G-E CONTROL



New rotor field circuit prolongs life of your motor and equipment. Offers: precise synchronization (within half a cycle); constant protection without "babying" the motor; automatic and instant field removal at slip cycle.

This factory assembled and tested unit is your assurance of accurate motor performance regardless of type of G-E synchronous motor control you require — full-voltage magnetic, reduced-voltage magnetic, or reduced-voltage semi-magnetic. Standard, heavy duty components are panel mounted, enclosed in a compact, steel cabinet. Short-circuit protection with air-circuit breakers or high-voltage fuses is available. All parts easily accessible, little maintenance required, adjustments easy.

This is the quality control your synchronous motor needs for really efficient operation. It is specially engineered and built for years of service for *your* application. Write for the bulletin in the coupon.

Apparatus Dept., Sec. K770-4, General Electric Company
1 River Road, Schenectady 5, N. Y.

Gentlemen:
I would like more information on the advantages of synchronous motors. Please send me the indicated descriptive literature.

☐ GEA-529D ☐ GEA-5113 ☐ GEC-505

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Street ..... City .....

State .....

GENERAL ELECTRIC

WHERE'S

YARWAY now offers a COMPLETE SYSTEM for constant, accurate check

Yarway Remote Liquid Level Indicator, operated by the pressure differential between a constant head and the varying head in the boiler drum. Never under pressure. No stuffing boxes.

YARWAY

YOUR BOILER WATER LEVEL?

Dependable, constant indication of boiler water and other liquid levels is now available with a complete Yarway system.

At the boiler drum—Yarway offers the well-known Hi-Lo Alarm Water Column with tubular or pressure-sealed Flat Glass gages with "floating assembly" that reduces leakage and glass breakage.

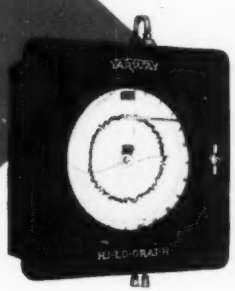
On the instrument panel—Yarway's Remote Liquid Level Indicator, operated by the boiler water itself, gives instant, accurate indication at eye level. Or the Yarway HI-LO-GRAPH Recorder gives both indication and round-the-clock recording of the water level.

Throughout the plant—at any desired locations, Yarway Remote Signal Alarms (lights or horns) operated by a Control Unit on the Yarway Indicator, or Recorder, give additional checks on boiler water levels.

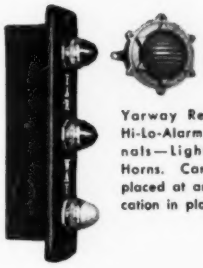
Why not let a Yarway Engineer show you how this Yarway System can increase the efficiency and safety of your power plant operation?

For complete information on Yarway Indicators ask for Bulletin WG-1822.

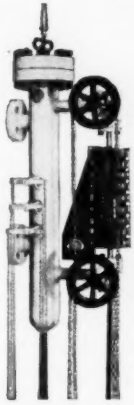
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Penna.



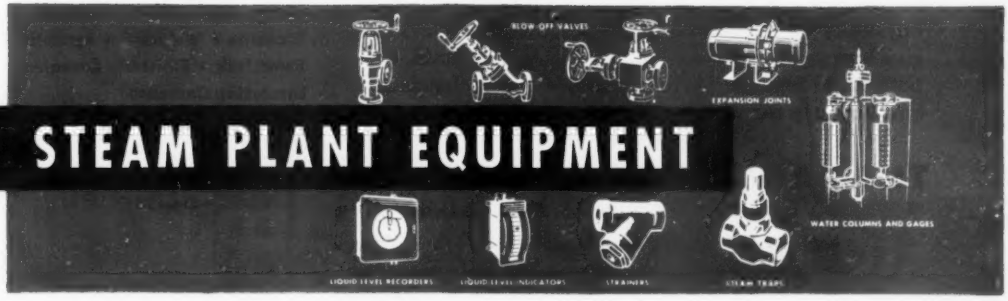
Yarway HI-LO-GRAPH Recorder provides not only water level indication but a 24-hour recording of water levels. See Bulletin WG-1830.

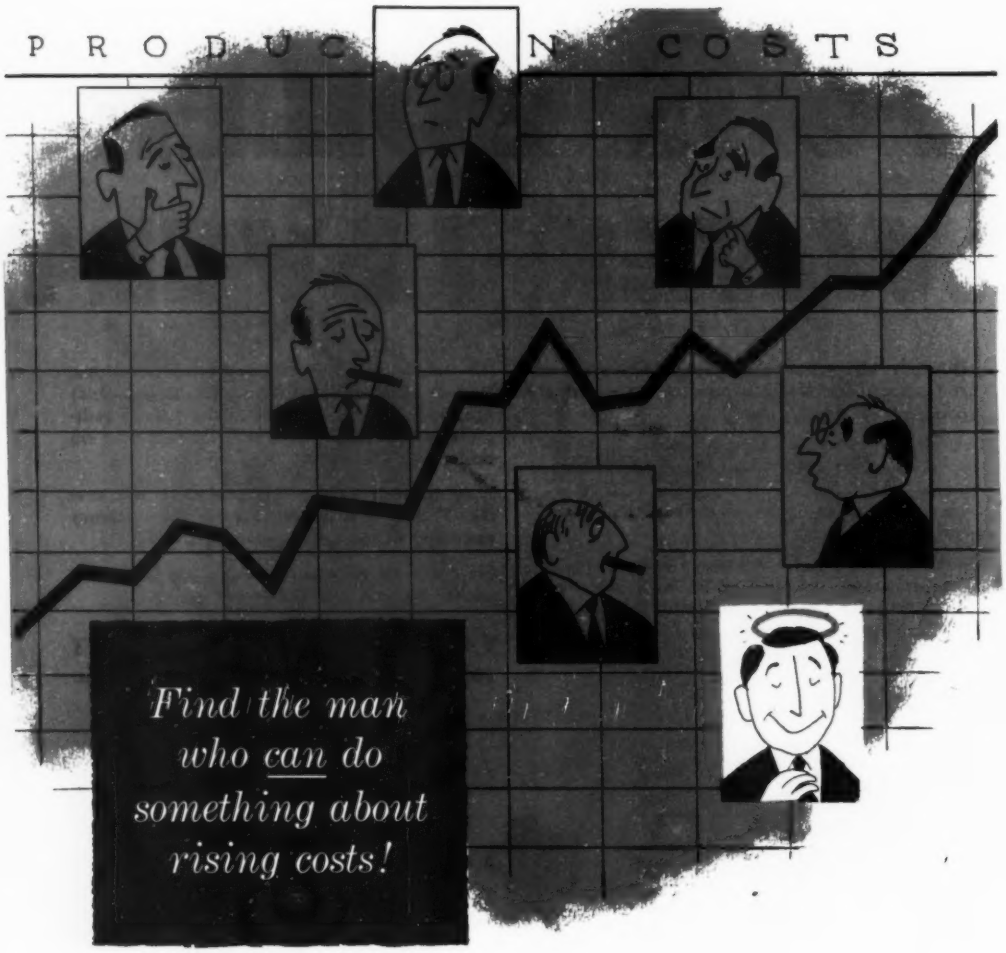


Yarway Remote Hi-Lo-Alarm Signals—Lights or Horns. Can be placed at any location in plant.



Yarway Floatless Hi-Lo Alarm Water Column with Vertical Flat Glass Gages with "Floating Assembly." See Bulletin WG-1811





In this day of upward spiraling operation costs, there's one man who can effect production economies. He's the man whose responsibility is getting the most heat and power from each fuel dollar expended. He knows that you get maximum efficiency from Eagle-Picher Industrial Insulations — because they're durable, chemically and physically stable, water-repellent *mineral wool*. They give long years of service, and are easy to maintain, economical to replace. There's an Eagle-Picher Insulation that can help reduce *your* operating expenses!

Let these Eagle-Picher products save you money . . . power . . . time

Insulating Felts
Supertemp Block • Blankets
Loose Wool • Pipe Covering
Stalastic • Insulseal • Insulstic
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Insulating Cements

THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

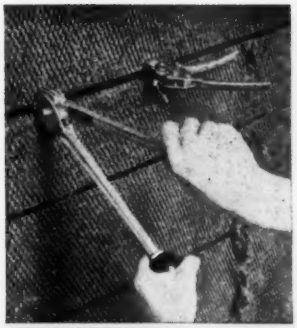
Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER *Since 1843*

The perfect answer

FOR MAXIMUM FUEL SAVINGS AND EXACT TEMPERATURE CONTROL

For a completely effective, low-cost insulation combination, you can't beat the teamwork of Eagle-Picher Mineral Wool Blankets, Supertemp Blocks, Super "66" Cement and Insulseal. They work effectively to give your equipment higher efficiency . . . cut operating costs . . . and help to provide perfect, precise control over temperatures.



EAGLE-PICHER MINERAL WOOL BLANKETS

These blankets satisfy the need for a convenient method of quickly and efficiently insulating flat or curved surfaces on larger types of heated equipment. Mineral wool is felted and secured between flexible metal fabric. Outstanding physical and chemical stability enable Eagle-Picher Blankets to resist water, steam, corrosive fumes and normal vibration.

EAGLE-PICHER SUPERTEMP BLOCKS

Eagle-Picher Supertemp Blocks are lightweight (approximately 16 lbs. per cu. ft.). Can be cut easily with knife or saw to fit off-shaped areas . . . they fit snugly over minor irregularities. They're strong and have high refractory value. Withstand temperatures up to 1700 F. Conductivity at 512 F. approximately 0.43...all standard sizes, from 3" x 18" to 12" x 36" . . . in thicknesses from 1" to 4".

EAGLE-PICHER SUPER "66" INSULATING CEMENT

Super "66" is all-purpose, rust-inhibitive, extremely adhesive insulating cement. "Springy ball" pellets don't collapse after application . . . give great coverage, retain their thermal efficiency. 100 lbs. covers 65 sq. ft. —1 inch thick! Easily applied with trowel, over flat and irregular surfaces. Efficient for temperatures up to 1800 F. Reclaimable when used on equipment whose temperatures go up to 1200 F.!

EAGLE-PICHER INSULSEAL

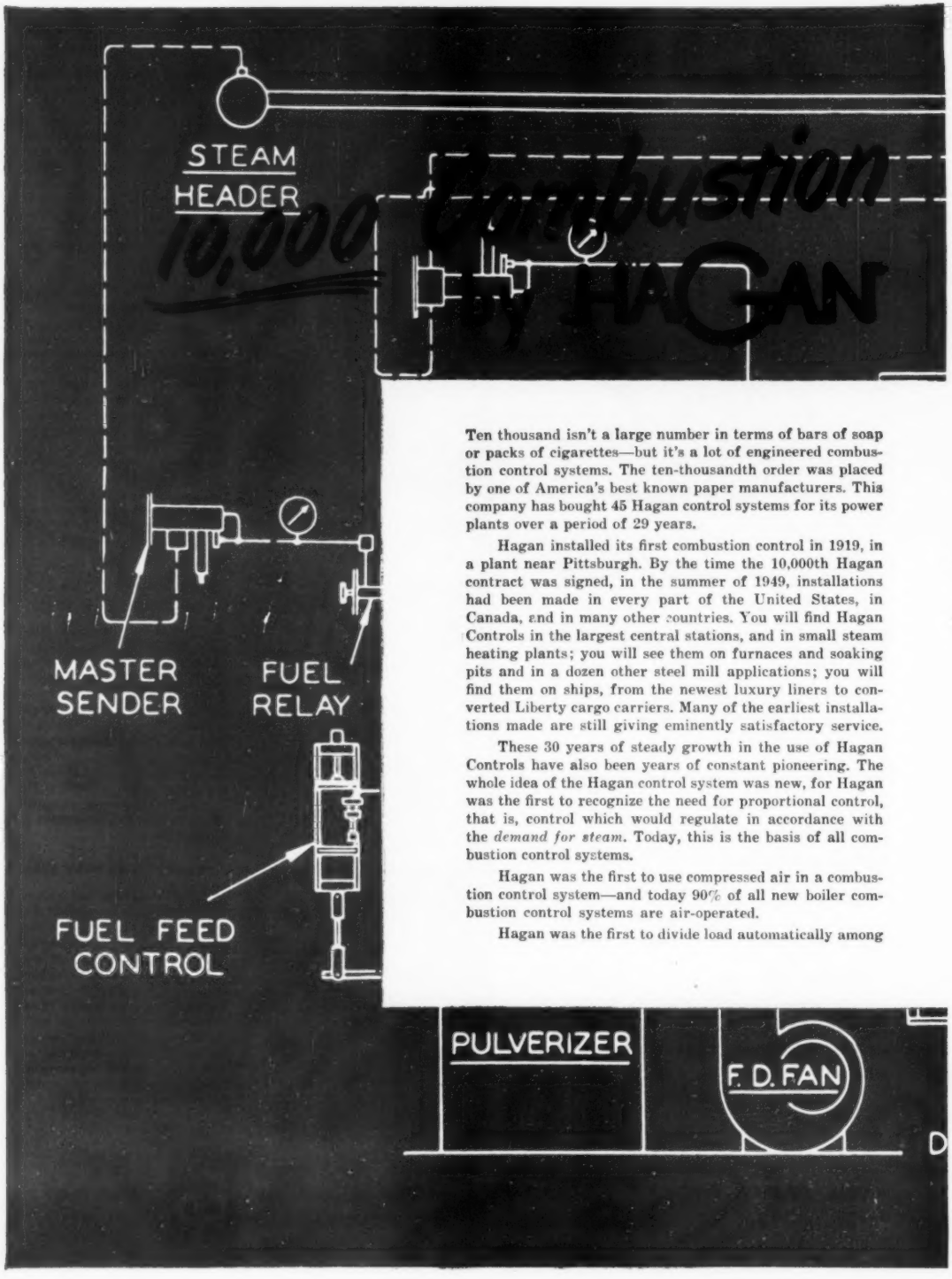
A tough, weatherproof, protective coating for insulation. For temperatures up to 450 F. Applied as a plastic, its smooth troweling qualities assure uniform coverage, proper thickness. It protects insulation from air infiltration, fumes, rain, snow, vibration, punctures, and withstands severe service, indoors or out. Dries to a smooth, rich black, has a neat appearance on hot or cold surfaces . . . may be washed or painted.

THE EAGLE-PICHER COMPANY *General Offices:* Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER

Since 1843



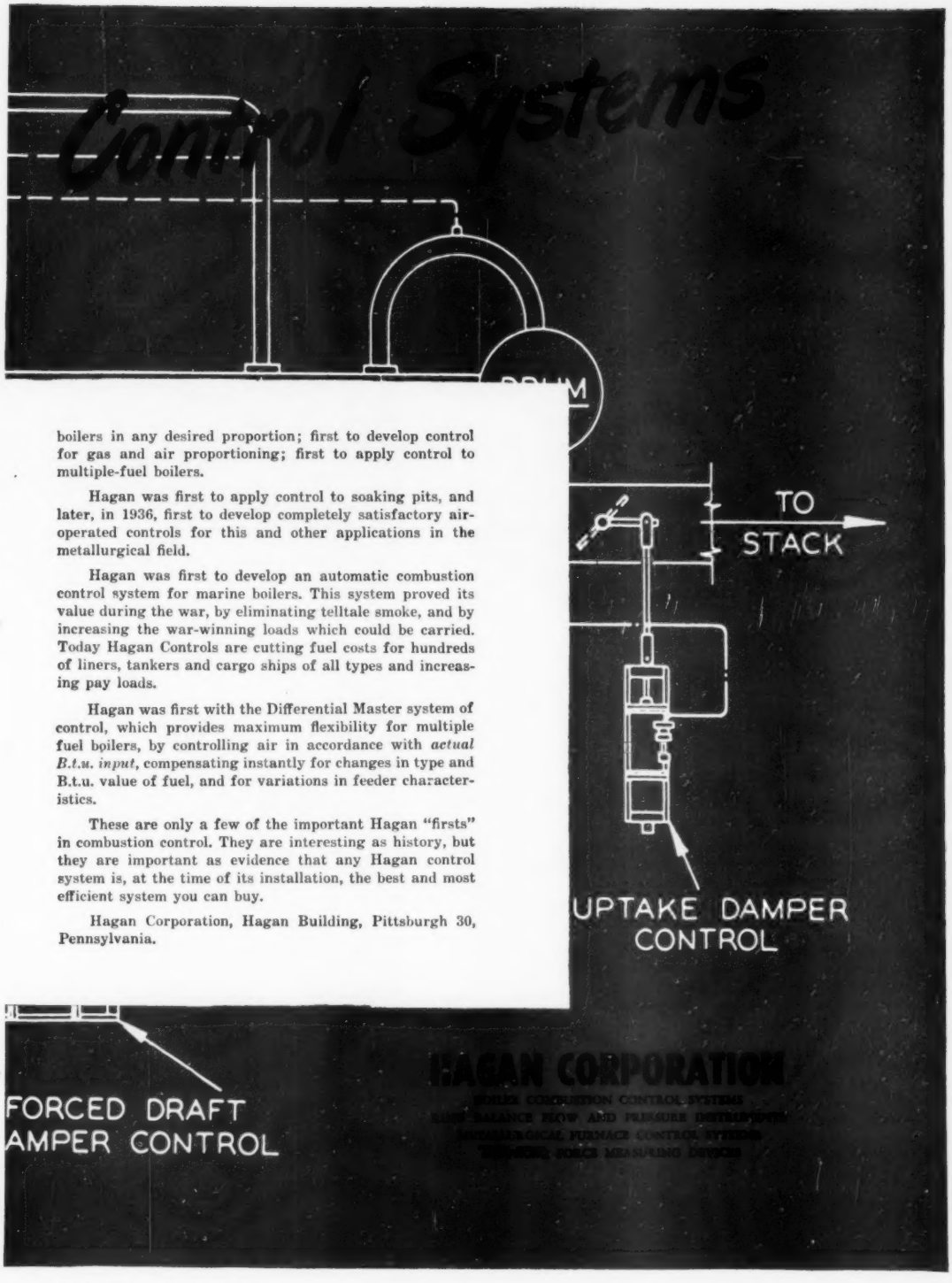
Ten thousand isn't a large number in terms of bars of soap or packs of cigarettes—but it's a lot of engineered combustion control systems. The ten-thousandth order was placed by one of America's best known paper manufacturers. This company has bought 45 Hagan control systems for its power plants over a period of 29 years.

Hagan installed its first combustion control in 1919, in a plant near Pittsburgh. By the time the 10,000th Hagan contract was signed, in the summer of 1949, installations had been made in every part of the United States, in Canada, and in many other countries. You will find Hagan Controls in the largest central stations, and in small steam heating plants; you will see them on furnaces and soaking pits and in a dozen other steel mill applications; you will find them on ships, from the newest luxury liners to converted Liberty cargo carriers. Many of the earliest installations made are still giving eminently satisfactory service.

These 30 years of steady growth in the use of Hagan Controls have also been years of constant pioneering. The whole idea of the Hagan control system was new, for Hagan was the first to recognize the need for proportional control, that is, control which would regulate in accordance with the *demand for steam*. Today, this is the basis of all combustion control systems.

Hagan was the first to use compressed air in a combustion control system—and today 90% of all new boiler combustion control systems are air-operated.

Hagan was the first to divide load automatically among



boilers in any desired proportion; first to develop control for gas and air proportioning; first to apply control to multiple-fuel boilers.

Hagan was first to apply control to soaking pits, and later, in 1936, first to develop completely satisfactory air-operated controls for this and other applications in the metallurgical field.

Hagan was first to develop an automatic combustion control system for marine boilers. This system proved its value during the war, by eliminating telltale smoke, and by increasing the war-winning loads which could be carried. Today Hagan Controls are cutting fuel costs for hundreds of liners, tankers and cargo ships of all types and increasing pay loads.

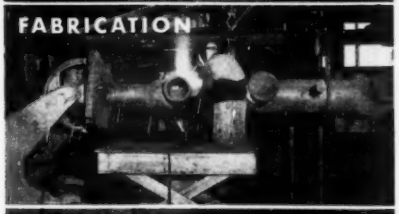
Hagan was first with the Differential Master system of control, which provides maximum flexibility for multiple fuel boilers, by controlling air in accordance with *actual B.t.u. input*, compensating instantly for changes in type and B.t.u. value of fuel, and for variations in feeder characteristics.

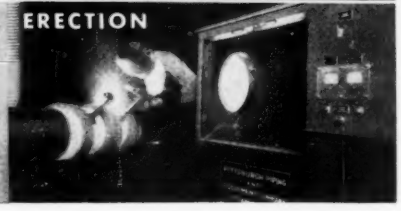
These are only a few of the important Hagan "firsts" in combustion control. They are interesting as history, but they are important as evidence that any Hagan control system is, at the time of its installation, the best and most efficient system you can buy.

Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

There's Only 1 RESPONSIBILITY

WHEN YOU TURN THE COMPLETE POWER PIPING JOB OVER TO P.P.&E.





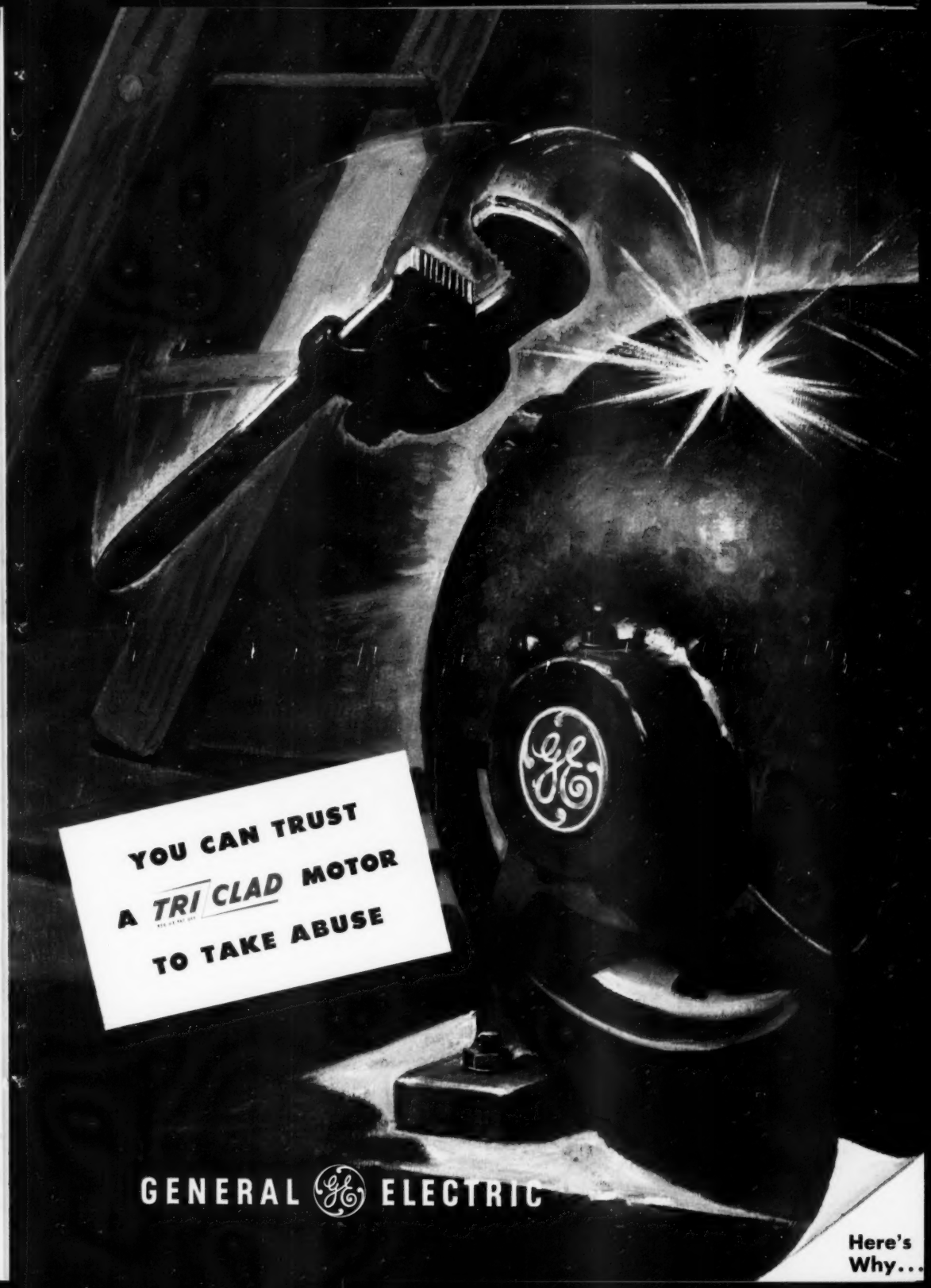
Simplify responsibility on your next power piping installation—entrust the complete job to P.P.&E. These are a few of the advantages:

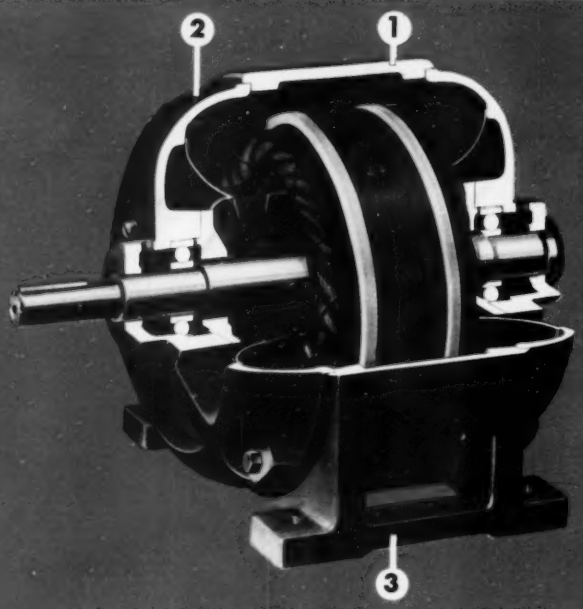
- Far less detail work for you.
- Correct interpretation of blueprints.
- Efficient detailing of shopwork for best coordination with field requirements.
- Maximum amount of system prefabricated, stress-relieved, model tested, as well as tested under ideal shop conditions.
- Field erection supervised by specially-trained personnel with a minimum of waste motion.

All these responsibilities—and many others—are made into one . . . *ours* . . . when the *complete* high pressure piping contract is turned over to us. Consult our nearest representative for futher information.

Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston


YOU CAN TRUST
A TRI CLAD MOTOR
TO TAKE ABUSE
GENERAL ELECTRIC
Here's
Why...



Notice the thick cross sections of a Tri-Clad's husky cast-iron stator frame (1) and end shields (2) . . . the integrally cast feet (3). Here you have a *rigid structural unity* that no other general purpose motor we've seen can match. Distortion of bearing alignment is well nigh impossible, even by severe blows, careless installation, or the heavy continuous radial loads some industrial drives impose. Notice, too, how Tri-Clad double-end ventilation provides *uniform* "air conditioning" throughout the motor.

You can trust a *TRI CLAD* motor to take abuse

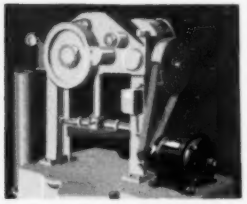
Teeth-rattling blows – accidental jarring – dripping liquids – they're all in a day's work for a Tri-Clad motor – the toughest general-purpose motor that hard-headed plant management can buy.

The cast iron structure which today protects more than a million and a half Tri-Clad motors, is one big reason for its stamina. It absorbs the shock of accidental blows and falling objects encountered in rigorous industrial service. It provides vastly superior resistance to rust and corrosion. Moreover, cast iron won't take on an injurious permanent "set"; thus it assures accurate shaft alignment and a permanent air-gap for the life of the motor. Thick-ribbed cast-iron end shields, too, take more than their share of punishment.

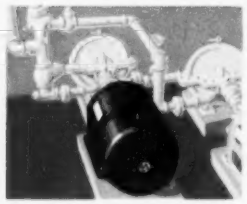
Want to standardize on a line of motors that can really **TAKE ABUSE?** Local stocks of Tri-Clad motors in your area mean **QUICK DELIVERY.** *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

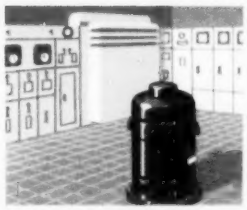
YOU CAN'T BEAT *TRI CLAD* EXTRA PROTECTION



G-E open (drippproof) induction motors for constant-load, constant-speed applications. From 1 to 2000 hp.

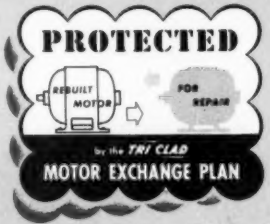


G-E totally enclosed motors for outdoor operation, in abrasive dusts, or corrosive fumes. From 1 to 1000 hp.

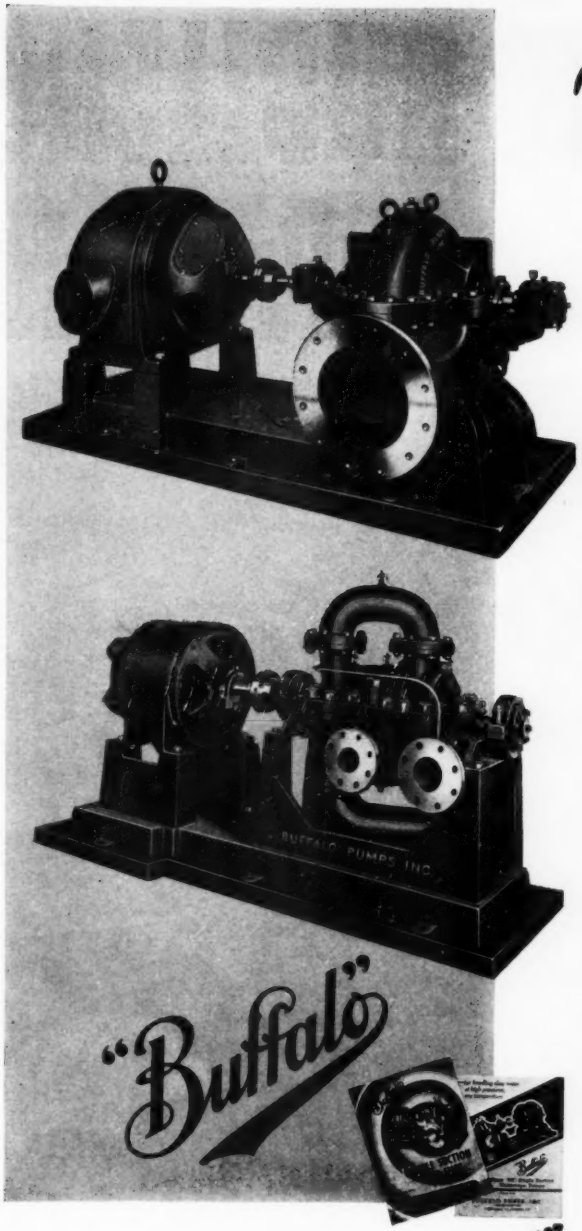


G-E vertical induction motors for pump drive, in streamline design. From 1 to 500 hp.

G-E capacitor motors for use on fans, blowers, pumps and compressors, with single-phase power. From ¾ to 5 hp.



Look for this **EXTRA** on the motor you buy!



Know Your

CLEAR WATER PUMPS

—The right choice for the job pays off!

"Buffalo" CLASS "SL" PUMPS for Severe Service, 10 to 10,000 gpm.

● "Buffalo" Pumps are specialists — each type proven most satisfactory in a particular type of job. If you want a double-suction pump to handle up to 10,000 gpm at heads up to 350 ft. on a punishing continuous service without worrying about maintenance, you'll want a "Buffalo" Type "SL" Pump! For the "SL" has literally the finest construction and materials obtainable—all oversize parts, extra big water passages in the sturdy casing, durable, peak-efficiency impeller—construction that makes its operation cheap over the years! Write for Bulletin 955-N and see the facts!

"Buffalo" CLASS "RR" PUMPS — For High Pressures

● Here's another "Buffalo" Pump that has set many an endurance and efficiency record on the job. The "RR" is especially suited to delivering against high heads—it's available in two and four stage models, 20 to 900 gpm., against heads clear up to 1500', any temperatures. These general service pumps are built ruggedly, from their husky stands to their heavy-duty bearings. Write for Bulletin 980-B, and get the facts that will make your choice of "Buffalo" Pump the best for the job—a choice you'll be satisfied with for many years to come!

GET ACQUAINTED with the pump YOUR installation requires! These are the factual bulletins to write for—No. 955-N and 980-B. Mailed to you without obligation, of course.

"Buffalo" PUMPS

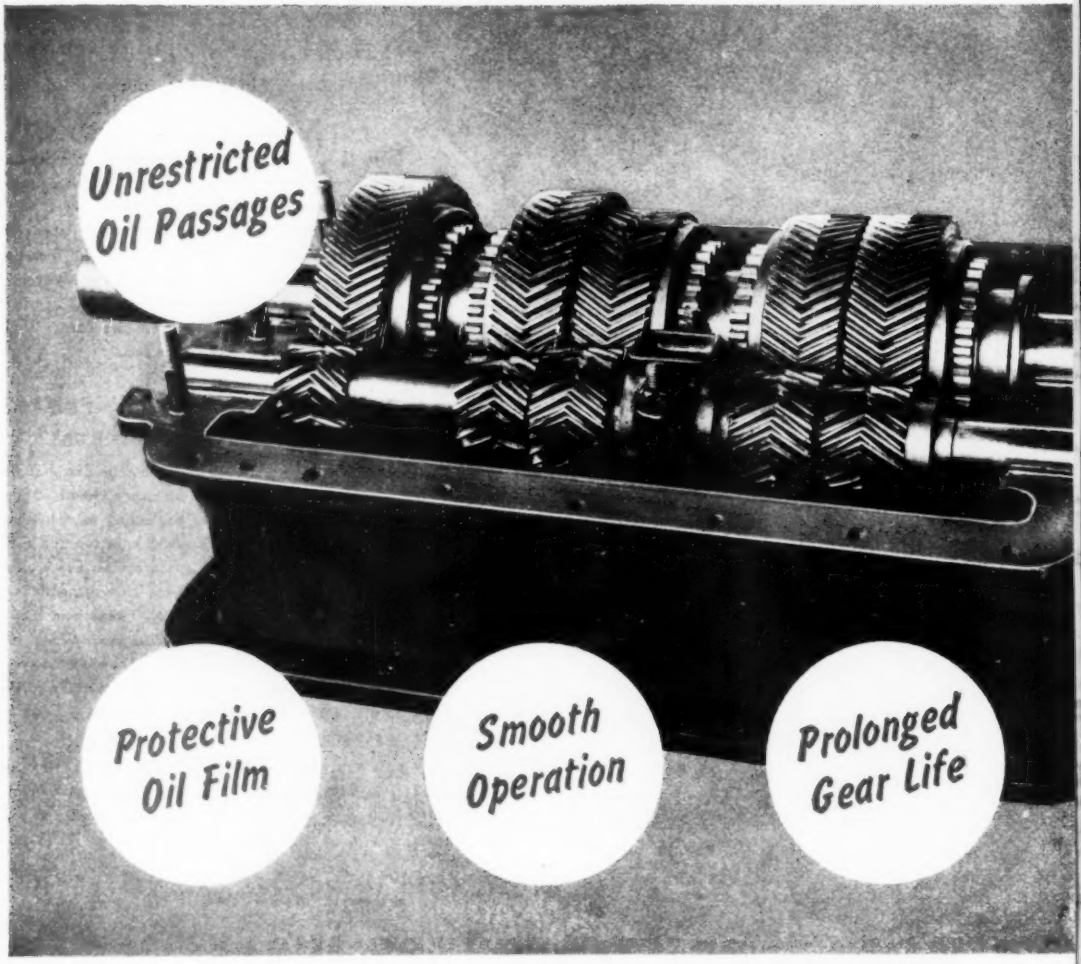
BUFFALO PUMPS INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

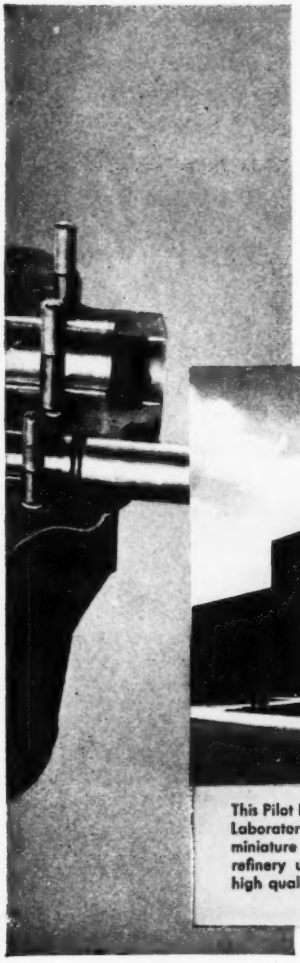
SINCLAIR RUBILENE To Promote



SINCLAIR

YOUR NEAREST SINCLAIR AGENT WILL GLADLY ARRANGE

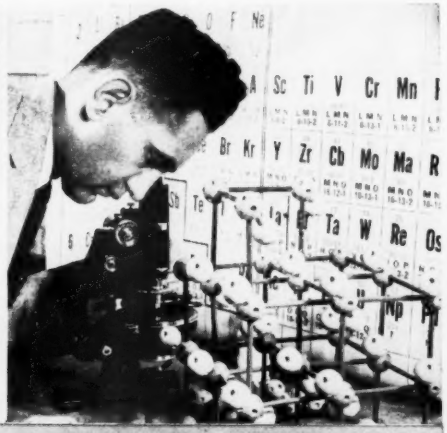
Withstands Punishment Gear Efficiency



Inside a Speed Reducer, the lubricating oil is being churned and temperatures run high. This promotes oil oxidation, and formation of acidic compounds, gum and sludge. The result is lower efficiency, accelerated bearing and gear wear—perhaps even complete failure.

With Sinclair RUBILENE as the lubricant, the danger of insufficient lubrication and excessive wear are no longer a worry. Product of the most modern refining processes, RUBILENE resists oxidation, thereby retarding the formation of damaging acidic compounds, gum and sludge. It is non-foaming, too. So, with a constant flow of protective oil to bearings and gears, RUBILENE stands up under the day-in-and-day-out continuous gear operation . . . without frequent need for draining or replacement. Try Sinclair RUBILENE Oils.

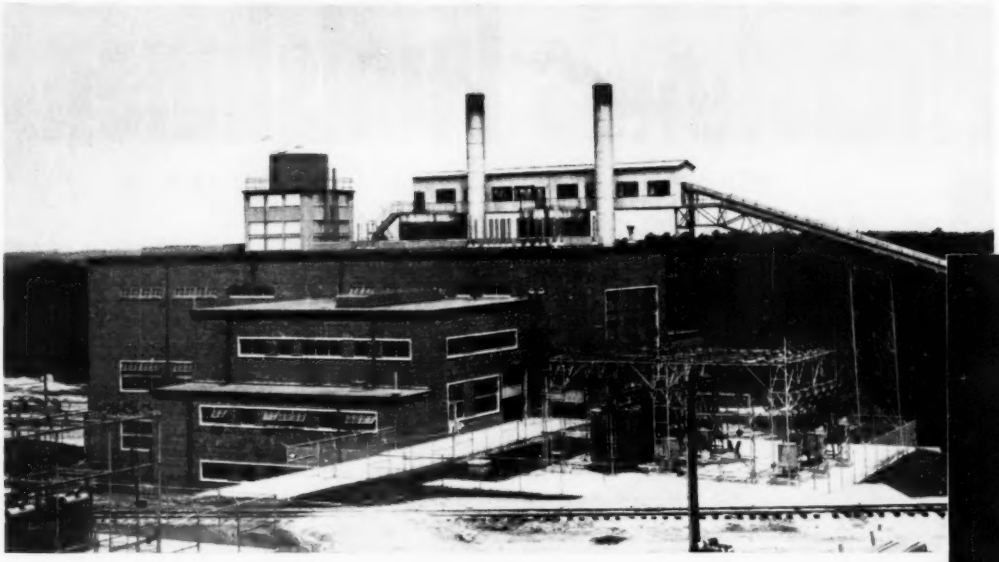
This Pilot Plant, part of the great Sinclair Research Laboratory at Harvey, Ill., provides space for six miniature operating replicas of commercial-sized refinery units. Continuous research explains the high quality of RUBILENE and other Sinclair Oils.



Making a study of crystal structure of catalysts, this Sinclair researcher at Harvey uses physical chemistry to develop refinery techniques in a never ending effort to bring industry better petroleum products at lower costs.

INDUSTRIAL OILS

FOR LUBRICATION COUNSEL, OR YOU MAY WRITE TO SINCLAIR REFINING COMPANY, 630 FIFTH AVE., NEW YORK 20, N. Y.



SPRINGS COTTON MILLS' Bleachery Division at Grace, S. C., is an outstanding development of one of the nation's largest textile manufacturers.

The power plant is based upon two 150,000 lb. per hour boilers. Large numbers of Lunkenheimer Valves including main steam, boiler feed, check and non-return valves, as well as small and large valves ranging from 125 to 1500 lb. standard for miscellaneous services, are used to control the power and process steam, powerhouse water supply, processing and fire protection.

This modern installation is another interesting example of the high regard in which Lunkenheimer Valves are held throughout all industry. If you are planning new construction or modernization of present facilities, it will pay you to specify Lunkenheimer Valves. Their reputation for lower-cost, trouble-free service is industry-wide.

ESTABLISHED 1862

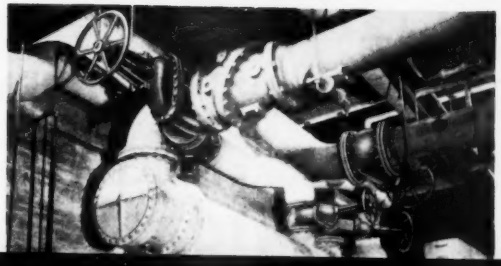
THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13 CHICAGO 6 BOSTON 10 PHILADELPHIA 34
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

BRONZE, IRON, STEEL, AND CORROSION RESISTANT ALLOY VALVES
AIR DEVICES, LUBRICATORS, AIRCRAFT FITTINGS

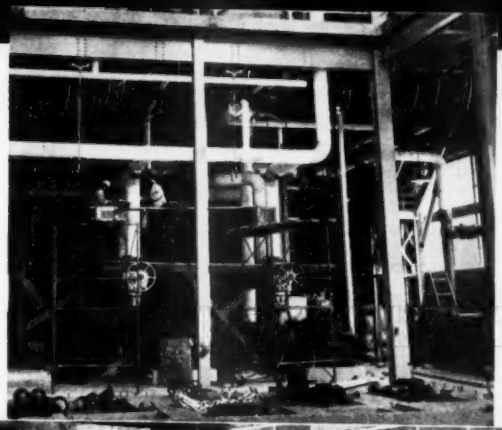


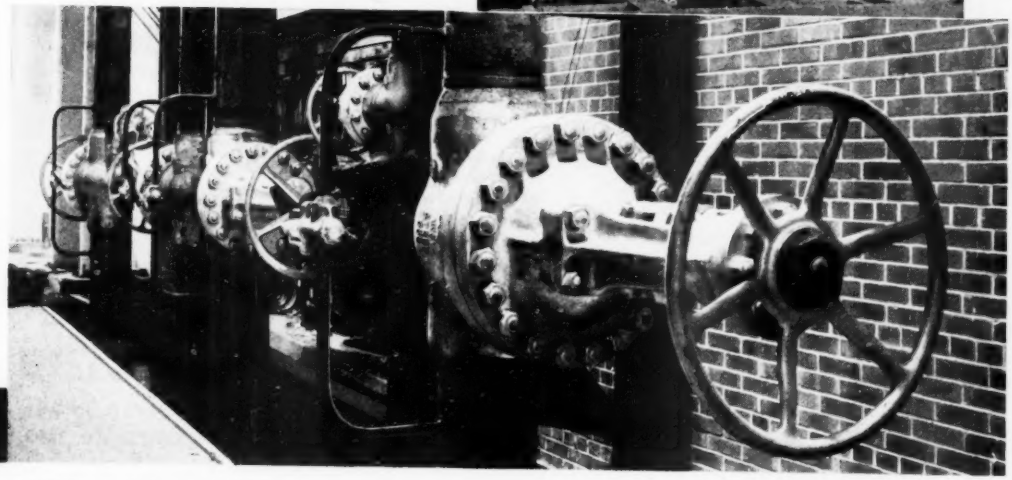
More power to Springs Bleachery

through LUNKENHEIMER VALVES

ARCHITECTS AND ENGINEERS:
Robert & Co., Inc., Atlanta, Ga.

CONTRACTORS:
Grinnell Co., Inc. Charlotte, N. C.

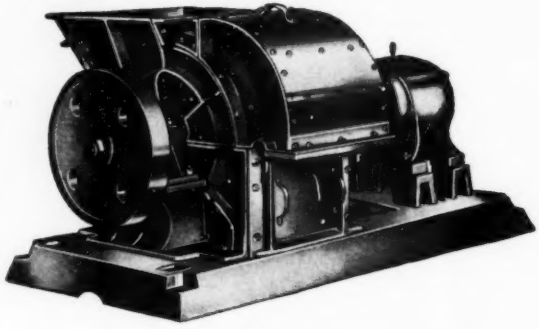




ASSURE MORE EFFICIENT *FIRING* THROUGH MORE EFFICIENT *PREPARATION* with AMERICAN CRUSHERS

Shown above is the preparation plant of the Windsor Power House Co., Power, W. Va., where the American Rolling Ring Crusher Model 425 (in insert) is in daily operation.

Quality of coal crushing is as important to combustion efficiency as the quality of coal itself—one reason why Americans are chosen by so many power plants to do the crushing job. The *splitting action* of Americans assures uniform sizing—no oversize—and fines are accurately controlled. The result: a dependable, constant yield of stoker or pulverizer size to assure a uniform, responsive firebed—for greater operating efficiency.



Designed especially for power plants, the American "S" Crusher is a compact, complete crushing operation which is installed in minimum headroom without extensive conversion—and with no auxiliary crushing facilities. Nine different sizes, with capacties from 25 to 500 TPH.

Write for bulletin on efficient coal preparation in power plants.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

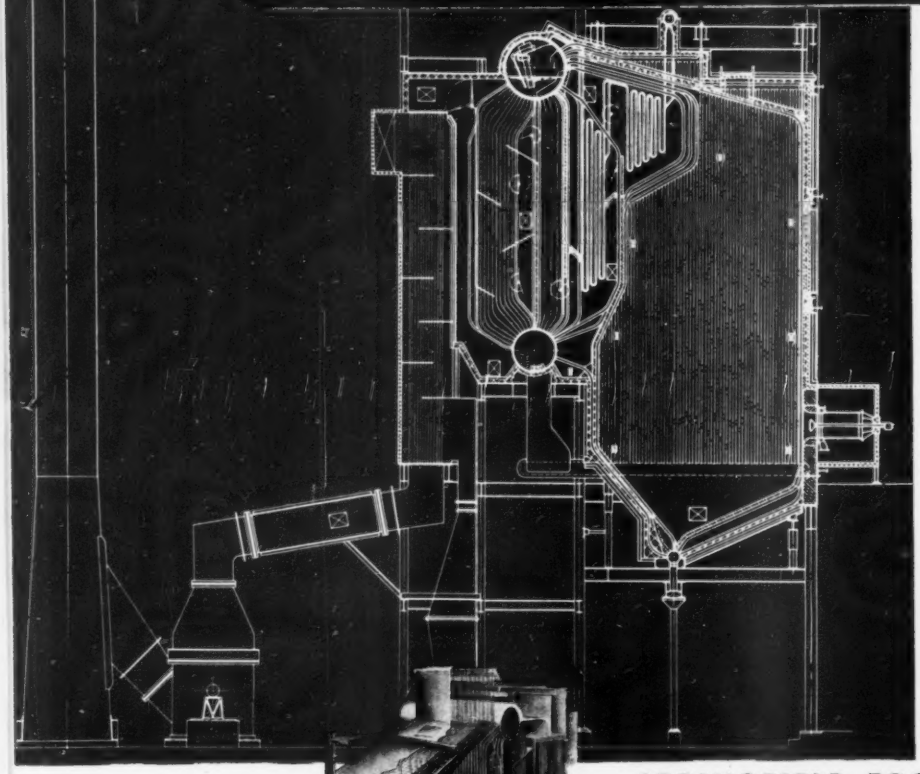
1349 MACKLIND AVE.
ST. LOUIS 10, MO.

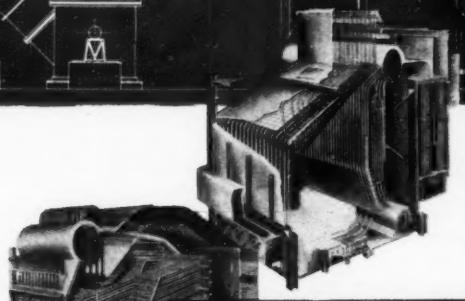
More Power for TEXAS!

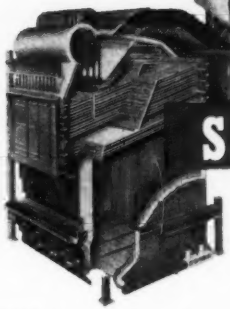
THIS new 2-drum steam generator is a typical example of the modern, economical units Springfield offers to meet user's particular requirements. It is designed to handle loads ranging from 30,000 lbs. to 130,000 lbs., or a continuous capacity of 115,000 lbs. of steam per hour at 635 psig operating pressure with 835°F. steam temperature at superheater outlet. The unit is designed for outdoor installation with a steel clad insulated setting and for firing with gas or oil, or in the future with pulverized lignite.

Springfield specializes in building boilers to "fit the job". We will be glad to submit a proposal covering your requirements. Write to our main office in Springfield, or check with your nearest Springfield Boiler Co. representative.

Location: Brazos River Transmission Cooperative, Inc., Belton, Texas
Consulting Engineers: Laramore and Douglass, Inc., Chicago, Ill.







SPRINGFIELD BOILERS

CHECK WITH YOUR CONSULTING ENGINEER ON YOUR MODERNIZATION AND NEW PLANT PROJECTS

SPRINGFIELD PRODUCTS

BENT TUBE STEAM GENERATORS—Modern designs for capacities from 10,000 lbs. up.
STRAIGHT TUBE BOILERS—Specially designed for capacities from 5,000 to 450,000 lbs. per hour and higher.
STANDARDIZED TYPE MC BOILERS—Standardized for quicker delivery and lower cost. Sizes 7,500 to 17,800 lbs. per hour.
WATER COOLED FURNACES—Heavy duty water walls. Exclusive center water wall construction for larger units.
SUPERHEATERS — AIR HEATERS — ECONOMIZERS — Individually designed to meet requirements.

See our catalog in SWEET'S

SPRINGFIELD BOILER CO.

1953 E. Capitol Ave., Springfield, Illinois

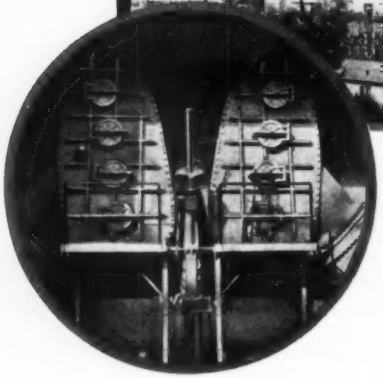
WORLDWIDE SALES AND SERVICE

NEW YORK • PHILADELPHIA • WASHINGTON, D.C. • DETROIT • KANSAS CITY • HOUSTON
CHICAGO • ST. LOUIS • ST. PAUL • PORTLAND, ORE. • Export: READING, PA.

FOSTER WHEELER CONDENSERS

are serving units of 100,000 kw and larger —

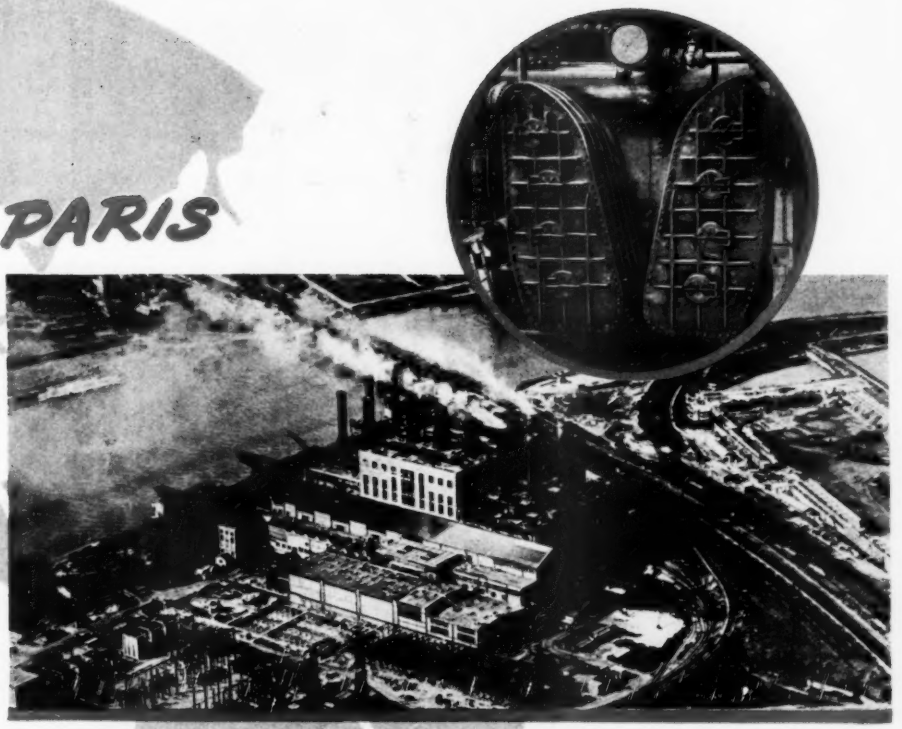
— FROM SAN FRANCISCO



Pacific Gas & Electric Company's Station "P" at San Francisco as it appears with its new extension which houses two 100,000 kw turbo-generators. Each unit is served by a Foster Wheeler cross-flow surface condenser. Feedwater heaters, evaporators and house condensers were also supplied by Foster Wheeler. Stone & Webster were consulting engineers.

FOSTER WHEELER CORPORATION • 165 BROADWAY

TO PARIS



Above is a view of the Genevilliers Power Station of the Union D'Electricite on the banks of the Seine in Paris, France. The plant has recently added a 100,000 kw turbo-generator served by a Foster Wheeler cross-flow surface condenser. Auxiliaries were also supplied by Foster Wheeler. Gibbs & Hill were consulting engineers.

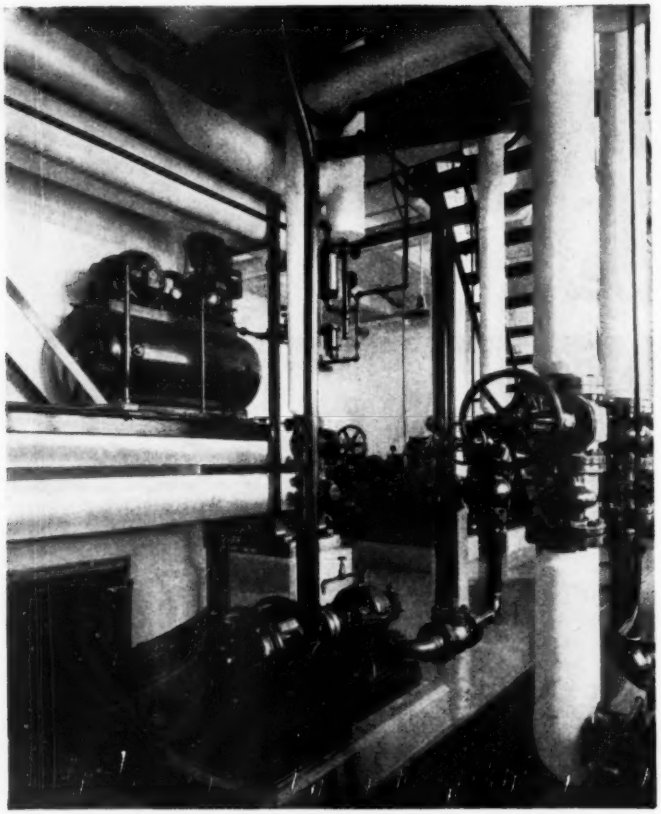
Stations employing one or more Foster Wheeler Condensers for 100,000 kw or larger units include:

Pacific Gas & Electric Co. (Station "P")	2 units	operating	100,000 kw each
Pacific Gas & Electric Co. (Moss Landing Station)	3 units	building	100,000 kw each
Super Power Company of Illinois (Powerton, Illinois)	2 units	operating	108,000 kw each
Philadelphia Electric Co. (Southwark Station)	2 units	operating	165,000 kw each
Public Service Electric & Gas Company (Sewaren Station)	3 units	operating	100,000 kw each
	1 unit	building	125,000 kw
Public Service Electric & Gas Company (Marion Station)	1 unit	operating	125,000 kw
Georgia Power Company (Plant Yates)	2 units	building	100,000 kw each
Alabama Power Company (Gorgas Steam Plant)	1 unit	building	100,000 kw
American Gas & Electric for Ohio Power Company (Tidd Station)	1 unit	operating	100,000 kw
Union D'Electricite, Paris, France (Genevilliers Power Station)	1 unit	operating	100,000 kw

A total of 19 units, each of 100,000 kw or larger.

NEW YORK 6, NEW YORK

FOSTER WHEELER



Pratt & Whitney's 14-mile K&M insulation starts here. It's fit for the job and looks fit!

Where K&M "*Featherweight*"® 85% Magnesia

Keeps up steam...keeps down cost...for 14 miles

Pratt & Whitney Division of Niles-Bement-Pond Company, West Hartford, Conn., has long been noted for fine machine tool, cutting tool and precision gauge manufacture. The scientific attitude is a Pratt & Whitney habit. They applied it to saving b. t. u.'s along 14 miles of steam lines throughout their large power plant and shops. That led them to use K&M "Featherweight" 85% Magnesia pipe insulation for maximum efficiency and permanence.

The inherent insulation effectiveness of K&M "Featherweight" 85% Magnesia comes from basic Carbonate of Magnesia. This is combined with clean Asbestos Fibre in correct proportion for needed weight-saving strength. Therefore it is easy to do a fast, shipshape insulation job whose continued efficiency does not depend on costly maintenance.

Designed for temperatures to 600° F., K&M "Featherweight" 85% Magnesia comes in all standard sizes. Like the other K&M insulation materials, it can save you waste—difficulty—money. Get help on any points by consulting your nearest K&M Distributor—an insulation expert.

Nature made Asbestos...

Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

IN CANADA—ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG and VANCOUVER

K&M Best in asbestos ®

Spins a centrifugal sixteen months

—24 hours a day!

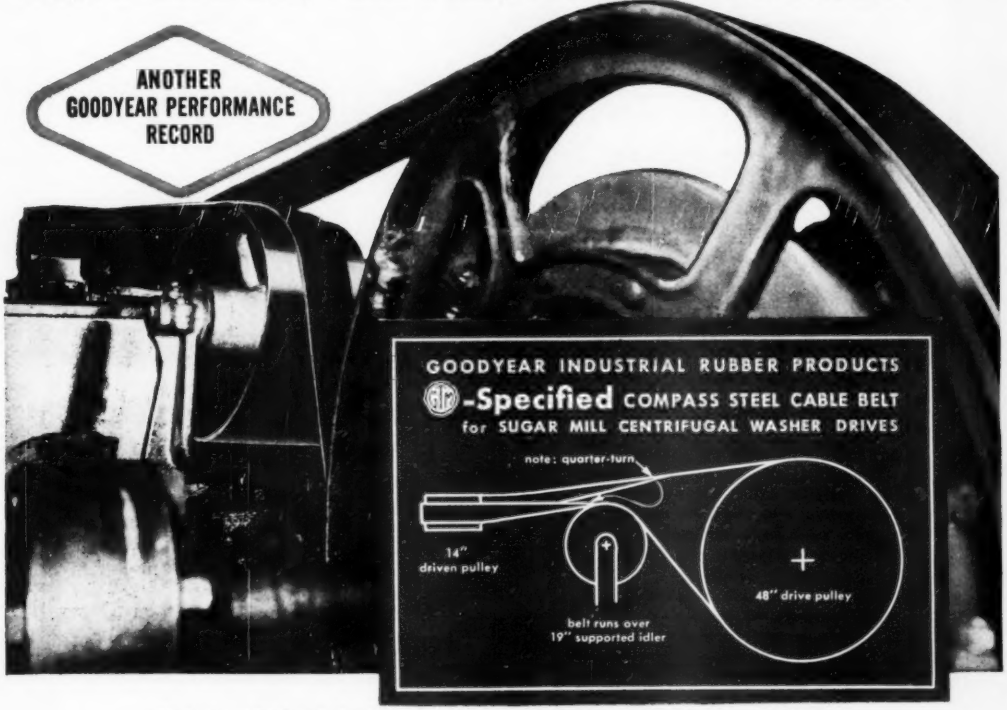
CENTRIFUGAL washers in a Louisiana sugar mill were "eating" belts of heaviest conventional construction—wearing out seven-inch-wide seven-ply belts at a rate only slightly less than one every two months. Reason was the heavy fluctuation in H.P. demands, coupled with a difficult quarter-turn drive. Belts had to be taken up frequently—cost the mill hundreds of dollars in lost production during their relatively short on-the-job life.

So costly was the drive—both in belts and maintenance—that the mill operator called in the G.T.M.-Goodyear Technical Man—to study the problem. To tame this "killer" drive, the G.T.M. recommended installing a COMPASS Steel Cable belt *only four inches wide.* The first belt installed ran for 16 months—24 hours a day! *And without a single shutdown for take-up.* So phenomenally successful was the performance of this belt that now all 18 washers in the mill are COMPASS equipped.

Today these 18 Goodyear belts are running the washers day in, day out—at a lower cost than the previous belts and with no maintenance problems. Secret of their performance is Goodyear's patented COMPASS construction, with truly endless, wiry-steel cables bonded in rubber to form the load-carrying "muscles" of the belt—giving it super-strength combined with practically zero stretch.

Wherever you have a problem drive, it will pay you to consult the G.T.M. for belting recommendations. Write him c/o Goodyear, Akron 16, Ohio.

FOR HOSE, FLAT BELTS, V-BELTS, MOLDED GOODS, PACKING, TANK LINING *built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.*



We think you'll like "THE GREATEST STORY EVER TOLD"—Every Sunday—ABC Network

GOODYEAR

Compass—T.M. The Goodyear Tire & Rubber Company

THE GREATEST NAME IN RUBBER

BOILER CONTROLS • INSTRUMENTS • PROCESS CONTROLS

The Republic Flow Meters Co. offers a complete manufacturing and engineering service in the field of measurement and control. We will be glad to co-operate with you in the solution of any metering or control problem, whether it involves a single instrument or the automatic control of an entire process or plant.

Republic engineers, in co-operation with your own engineers, will be glad to study your problem and make recommendations as to the most practical solution. Your inquiries will involve no obligation on your part.

BOILER CONTROLS

For All Types of Boilers

Republic offers a centralized, automatic system for controlling steam pressure, combustion, furnace pressure, excess pressure, boiler water level, etc.

Automatically regulates the fuel and air imput to a boiler in measured proportions and in a fixed ratio for the entire load range. Available for all sizes of boilers and all types of fuel firing.

FLOW METERS

Electrical and Mechanical

Republic electrical type remote reading flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for line pressures up to 10,000 p. s. i. and for all ranges of differential pressures.

Mechanical ring-balance meters are built for static pressures up to 2500 p.s.i. and to operate on differentials as low as 3 in. of water.

BOILER METERS

Record Steam Flow—Air Flow

The Republic boiler meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion.

The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.

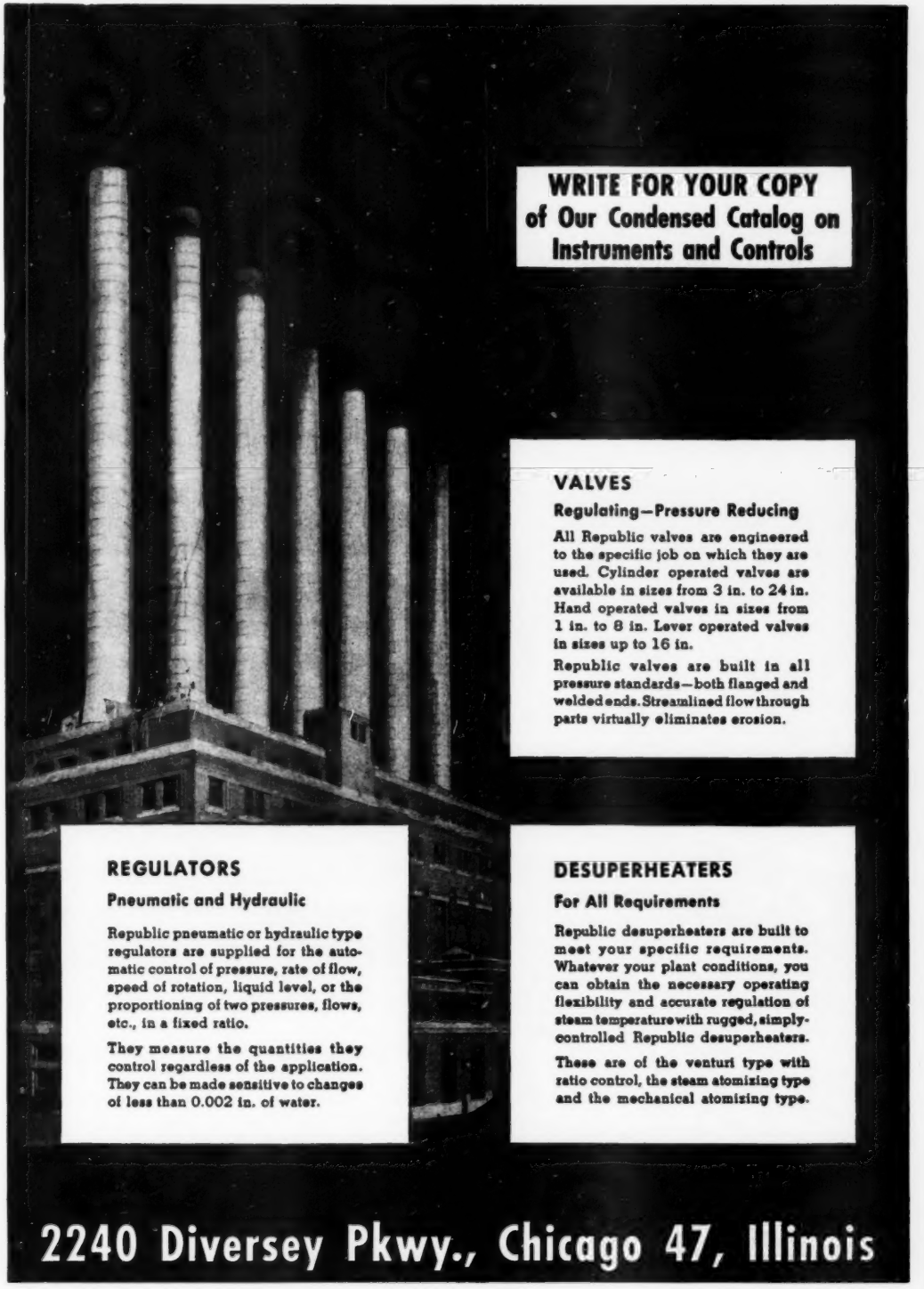
PNEUMATIC TRANSMITTERS

For Measurement and Control

Republic pneumatic transmitters are devices for converting process variables, such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables.

These air pressures can be used as the measuring impulse for the actuation of an automatic controller or a direct reading recorder.

REPUBLIC FLOW METERS CO.



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of Our Condensed Catalog on Instruments and Controls

VALVES

Regulating—Pressure Reducing

All Republic valves are engineered to the specific job on which they are used. Cylinder operated valves are available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 in.

Republic valves are built in all pressure standards—both flanged and welded ends. Streamlined flow through parts virtually eliminates erosion.

REGULATORS

Pneumatic and Hydraulic

Republic pneumatic or hydraulic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, liquid level, or the proportioning of two pressures, flows, etc., in a fixed ratio.

They measure the quantities they control regardless of the application. They can be made sensitive to changes of less than 0.002 in. of water.

DESUPERHEATERS

For All Requirements

Republic desuperheaters are built to meet your specific requirements. Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with rugged, simply-controlled Republic desuperheaters.

These are of the venturi type with ratio control, the steam atomizing type and the mechanical atomizing type.

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BEFORE YOU BUY ANY STOKER

See this new SPREADER STOKER CATALOG

Don't miss these important highlights!

- 14 Questions you should ask yourself before buying any spreader stoker.
- Shows how to feed wet or dry coal with equal reliability.
- Shows how to distribute coal evenly over entire length and breadth of fuel bed.
- Explains essential requirements of an effective cinder reinjection system.
- Discusses the efficient use of overfire air.
- Completely illustrated with installations featuring these principles.

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Gentlemen: Please send me a copy of the new catalog of Æ Perfect Spread Stokers. No obligation, of course.

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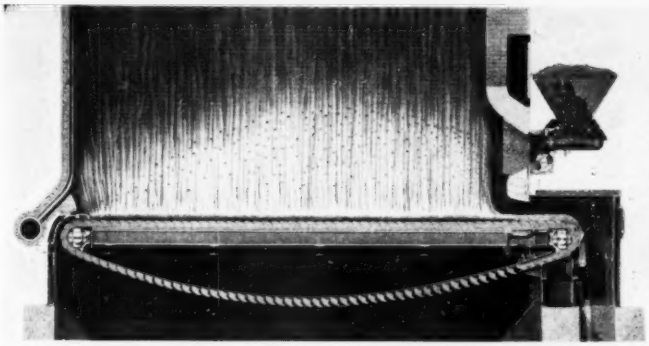


These 4 Spreader Stoker Features Mean Big Savings...

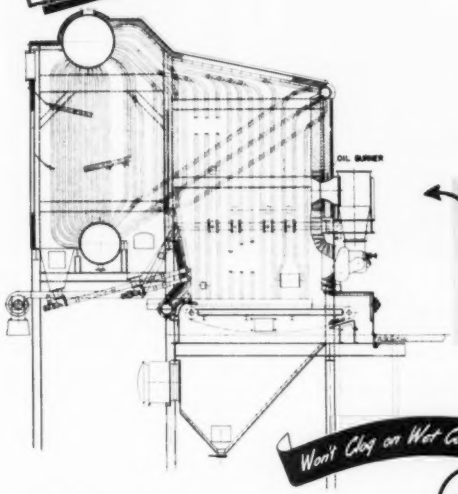
MAKE SURE YOU GET THEM ALL!

INSIST ON:

- Clogless feeding of wet or dry coal.
- Even coal Distribution.
- Cinder Return that Works.
- Adjustable Overfire Air.

Æ Perfect Spread Stokers give you all 4 of the features that mean efficient operation and fuel savings. An exclusive feeder that handles zero to 7500 lbs. of coal per hour without clogging and regardless of the condition of the coal. An overthrow impeller designed, after long research into all types, to spread the coal evenly. Separate cinder return lines run from every cinder drain point to the furnace. Each line is separate . . . cinders air-jet propelled. Overfire air nozzles are individually adjustabie.

You'll burn less fuel and generate more steam with an Æ Perfect Spread Stoker. And what you burn can be much lower in grade and therefore less costly. Æ adjustable overfire air and cinder return systems insure efficient combustion, reliable operation and offer better control of stack discharge. Write today for a free copy of illustrated catalog and complete information.



1948 installation in Ohio plant of large industrial company. Two Æ Perfect Spread Stokers with 2 feeder traveling grates. Wickes bent tube boilers. Units have normal capacity of 35,000 pounds per hour each, and a maximum output of 38,500 pounds per hour when burning 10,400 per lb. B.T.U. Ohio coal.

FREE—*Your copy of this informative catalog on Æ Perfect Spread Stokers will be sent you on request. Write. Dept. 10.*

Won't Clog on Wet Coal!

Other Æ Products: Taylor Stokers—Lo-Hed Electric Hoists & Car Pullers—Hele-Shaw Fluid Power—Marine Deck Auxiliaries.

Æ PERFECT SPREAD STOKER

With Traveling, Dumping or Stationary Grates

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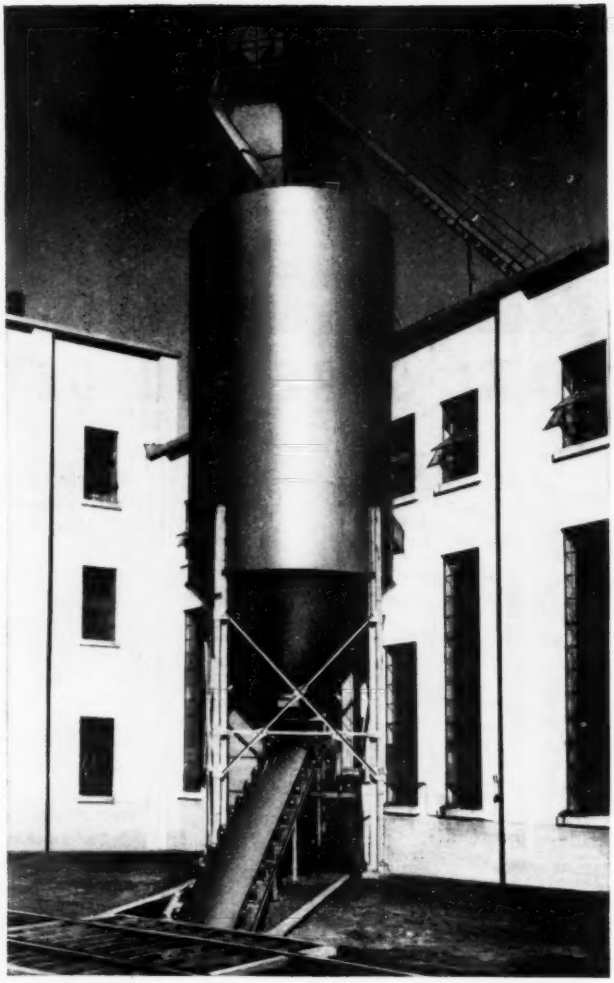
SPECIAL DELIVERY for "COAL"



From cars on siding to boiler room and to outdoor storage bin, for easy reclamation required a *special delivery* coal handling system designed by Stephens-Adamson engineers for this sugar refinery.

Industries of all kinds look first to S-A engineers for efficient, economical bulk materials handling systems. To solve your coal and ash handling problems, S-A engineers couple their many years experience in bulk handling with the most advanced techniques and engineering principles to assure maximum handling capacity at lowest cost per ton.

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ST. HILAIRE, QUEBEC, CANADA

Coal is picked up from track hopper by S-A belt conveyor and delivered to boot of a 65 ft. high bucket elevator which discharges into top of 120-ton capacity bin. Coal falls onto inclined live storage shelf and chutes out the side of bin to boiler room where an S-A weigh larry mounted on overhead 2-way traveling crane weighs and delivers it to either of 3 stoker hoppers. When live storage shelf is full, coal falls into bottom of bin until needed. Capacity of S-A handling system is 50 TPH.

STEPHEN S-A DAMSON MFG. CO.

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DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

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YOU CAN MOUNT a *Magic-Grip* sheave faster than any other sheave you can buy . . . and demount it just as fast. To mount, simply slide the sheave onto the shaft and tighten three screws. To demount, use the screws to break the grip of the tapered bushing and the sheave can be slid off easily.

You save time and eliminate the danger of damaged bearings and shafts from forcing and hammering. A hex socket wrench is the only tool needed and anyone can line up the sheave perfectly. Sizes 1 to 250 hp.

Most Complete V-belt Line

Get everything you need for your V-belt drives from one reliable source. *Texrope* offers the broadest line of V-belts, standard and variable-speed sheaves and speed changers plus the extra engineering skill that comes from more industrial V-belt installations in operation than any other manufacturer.

Get your copy of the 144 page *Texrope* Pre-Engineered Drive Manual from your A-C Authorized Dealer or Sales Office or write for Bulletin 20B6956. Also in Sweet's.

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MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

COCHRANE HYDROMATIC VALVE

for Manual or Automatic Operation of Zeolite Softeners

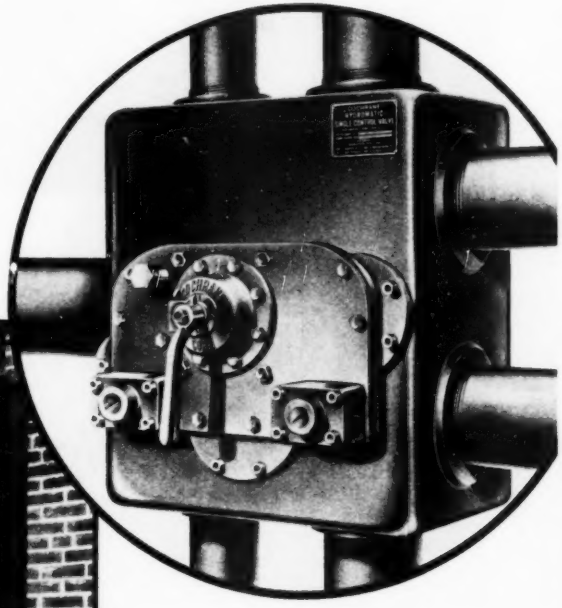
The Cochrane Hydromatic Valve is, in effect, a six-position valve, with four normal operating positions and two standby positions.

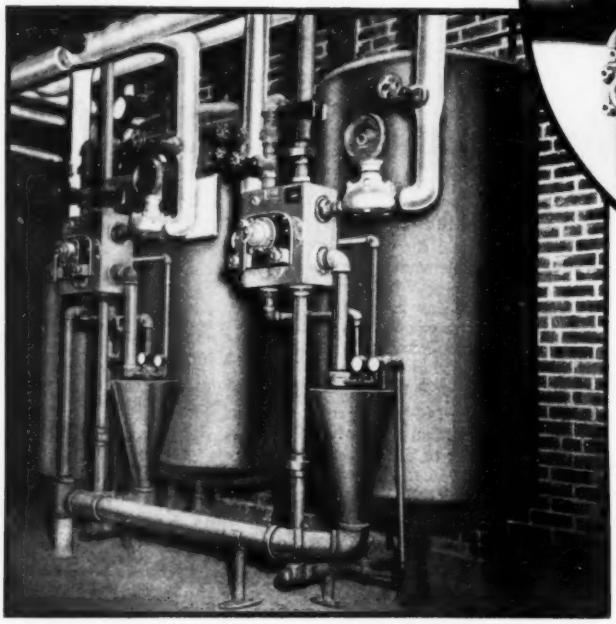
In the control of zeolite systems, the four operating positions provide separate control of backwash, regenerant feed, rinse and service, permitting flexibility in that separate flow rates may be assigned to each operation, unaffected by the requirements for other phases of operation.

Two standby positions are accommodated by the Hydromatic Valve: in one, the container being serviced by the valve is completely isolated from service lines; in the second, the container may be drained to bed level for inspection.

The Hydromatic Valve is pilot-actuated, power for operation of the valve members being provided by the raw water itself. This results in smooth operation and confines the force required for positioning—either manual or automatic—to a miniature disc-type pilot valve.

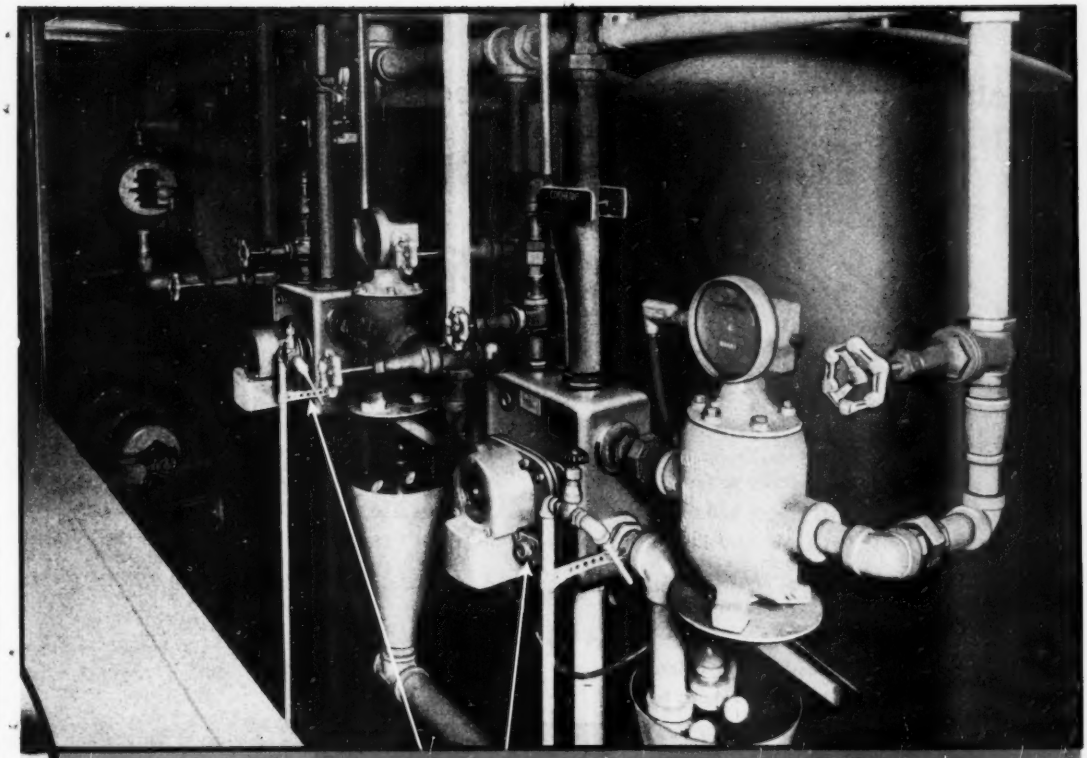
Operation of the Hydromatic Valve through its cycle of functions has been so simplified as to make it ideally suited to manual or automatic control.





Photograph at left shows manually operated Cochrane Zeolite Softeners with Hydromatic Valve at a large public utility.

Photo at upper right is an automatic installation of Zeolite Softeners at a large metal working plant.



The new Cochrane Hydromatic Valve, standard equipment on Cochrane Zeolite Softeners, is readily adaptable to automatic control. This is a fact of prime importance to any user of zeolite softeners for with the Hydromatic Valve, no change in the physical plant is necessary—merely the simple addition of a control box and drive motor.

Automatic operation of Zeolite Softeners makes possible economies in the amount and cost of the zeolite materials that often offset the cost of the control accessories, aside from the convenience of the automatic operation.

The points in favor of Cochrane Automatic Zeolite Softening System with the Hydromatic Valve are these:

1. Simplest and most positive single control valve ever built—six valves in one.
2. Automatic Control with the Hydromatic Valve means merely the addition of control box and drive motor—no changes in the physical plant.
3. Cost of labor attendant on manual operation is eliminated.
4. No objection to shorter regeneration period permitting savings on amount and capacity of zeolite materials.

Write today for details. Use the coupon.

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SOFTENERS • FILTERS • DEAERATORS • SPECIALTIES

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Please send me a copy of your latest bulletins on Zeolite Softeners and the Hydromatic Valve.

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Satisfactory service for over 35 years on a

Tough Assignment, too!

Golden-Anderson

non-return VALVES

In thousands of tough applications Golden-Anderson Non-Return Valves are protecting life and property by automatically performing these three vital functions:

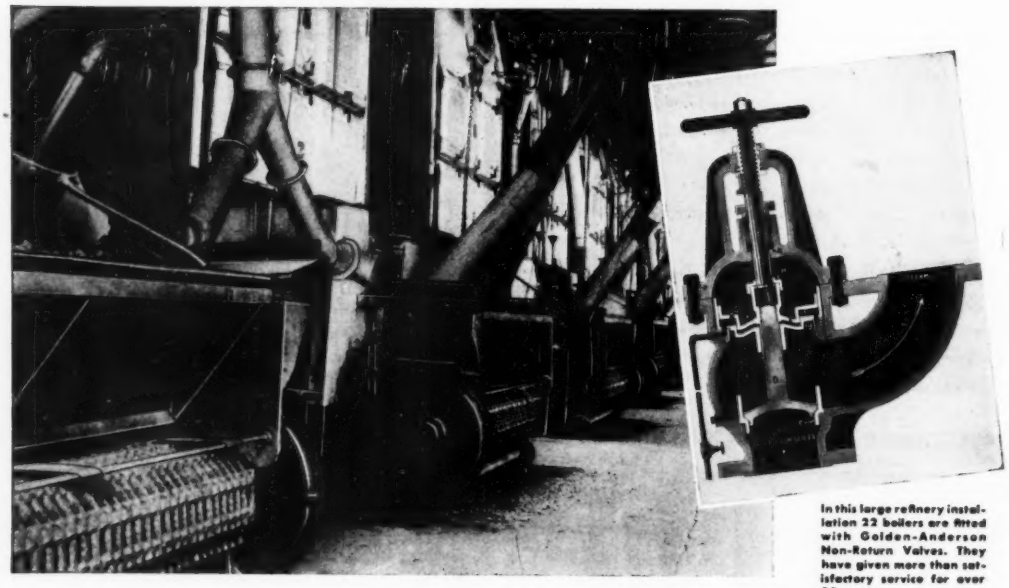
(1) Cut in boiler when pressure equals line-header pressure.

(2) Isolate boiler when pressure is lower than line-header pressure.

(3) Prevent steam flow from boiler in event of sudden line-header pressure drop.

"Double Corliss" dashpot assembly prevents banging, chatter or spinning under any flow conditions. Write for technical catalog today.

LIFE AND PROPERTY PROTECTION VALVES SINCE 1905

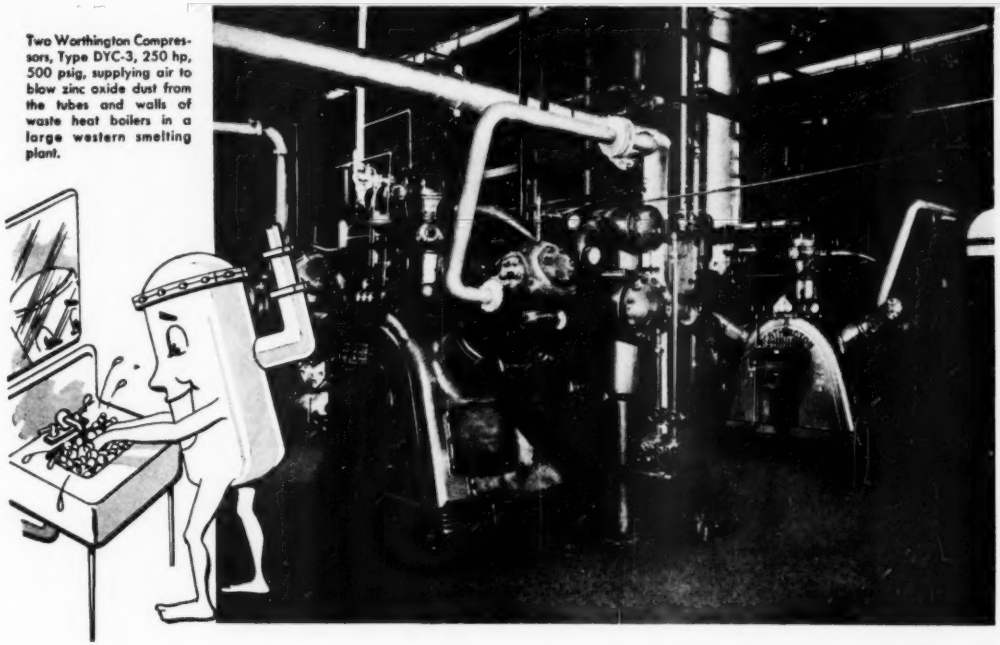


In this large refinery installation 22 boilers are fitted with Golden-Anderson Non-Return Valves. They have given more than satisfactory service for over 35 years.

GA

GOLDEN-ANDERSON Valve Specialty Co.

KEENAN BUILDING, Pittsburgh 22, Pa.



Two Worthington Compressors, Type DYC-3, 250 hp, 500 psig, supplying air to blow zinc oxide dust from the tubes and walls of waste heat boilers in a large western smelting plant.

Here's Your Modern, Money-Saving Way To Make Boilers "Come Clean"!

Worthington Compressors Do A Real Job Of Soot Blowing... Faster, Better, At Less Cost!

Boiler cleaning by hand is a messy, makeshift carry-over from the horse-and-buggy era. Today, soot-blowing by compressed air is an economic necessity. Originally developed for low pressure boilers, air soot blowing has shown so many advantages over steam as a cleaning agent that its use has now extended to central stations and big power plants throughout the nation.

The reasons are plain. Air soot blowing saves fuel and feed-water make-up, while lessening the possibility of tube erosion. It uses inexpensive, low-temperature piping, with piping insulation eliminated. It reduces soot blower maintenance, provides a dryer blowing medium and a more effective means of slag removal. Finally, its complete adaptability to automatic control reduces costly manual operation throughout long years of service.

"Heart" Of Every Soot Blowing System

is its compressors . . . and Worthington builds these for every application . . . builds them to give you longer, quieter, smoother service — and air at lower cost. For further facts proving *there's more worth in Worthington*, write for booklet, "Worthington Compressors for Soot Blowing". *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.* KO-8

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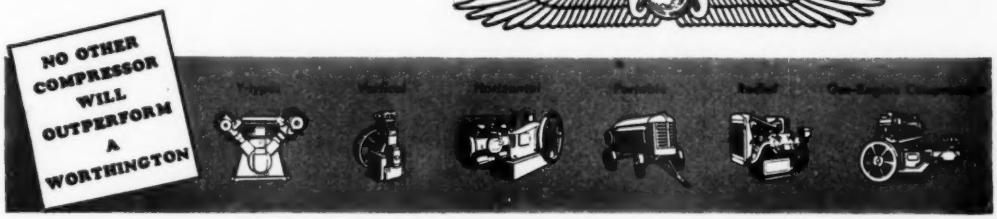

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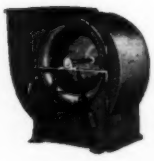
Everything that puts air to work for **Every** application



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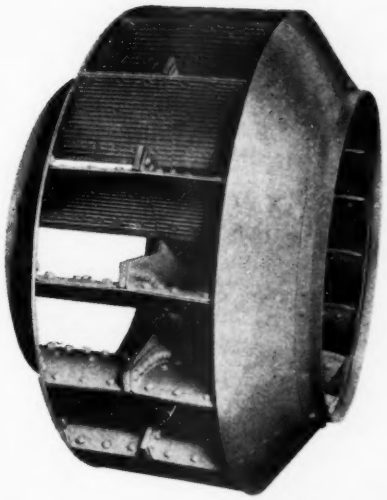
NO OTHER INDUCED DRAFT FAN CAN EQUAL THE PERFORMANCE OF THE STURTEVANT EROSION RESISTING WHEEL



Here's why:

1 Erosion of blade surfaces is sharply reduced by cut-away center support design. Streams of fly-ash meet—and dissipate their abrasive action on each other instead of on the wheel surface.

2 Fewer blades and absence of tie rods mean less obstruction to flow of fly-ash and less surface exposed to eroding action. Efficiency is high.

3 Ribbed blade liners are easily and quickly renewable, and can be welded locally when wear is concentrated. Wheel life is prolonged, maintenance costs cut and outage losses minimized.

Many years of service in hundreds of installations have proved conclusively that the E-R Wheel is the soundest investment you can make in induced draft equipment. You get this wheel in the highly efficient Sturtevant Turbovane® Induced Draft Fan. And it may be that your present fan can be modernized with the E-R Wheel. Ask your nearest Sturtevant office, or write Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

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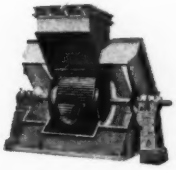

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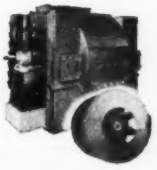

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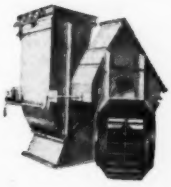
(Steel Plate)



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YOU CAN BE **SURE**.. IF IT'S

Westinghouse

NOW...

LIFE-LINE slashes a-c motor upkeep costs

Here's how Life-Line motors can save you half the upkeep cost, and more.

A recent survey of 114 large motor users—operating 131,626 a-c motors of 1 to 50 hp—shows how much motors *really* cost when you figure actual "Life Cost".

The survey shows that the yearly average cost of periodically lubricated motors was $270 for every hundred motors installed.

On lubrication cost alone, Life-Line motors saved this $270. That's because Life-Line requires no periodic lubrication—no added lubrication of any kind.

The survey also indicates that the yearly outage cost per hundred motors, for repairs and lost machine and man-hours, was $960.

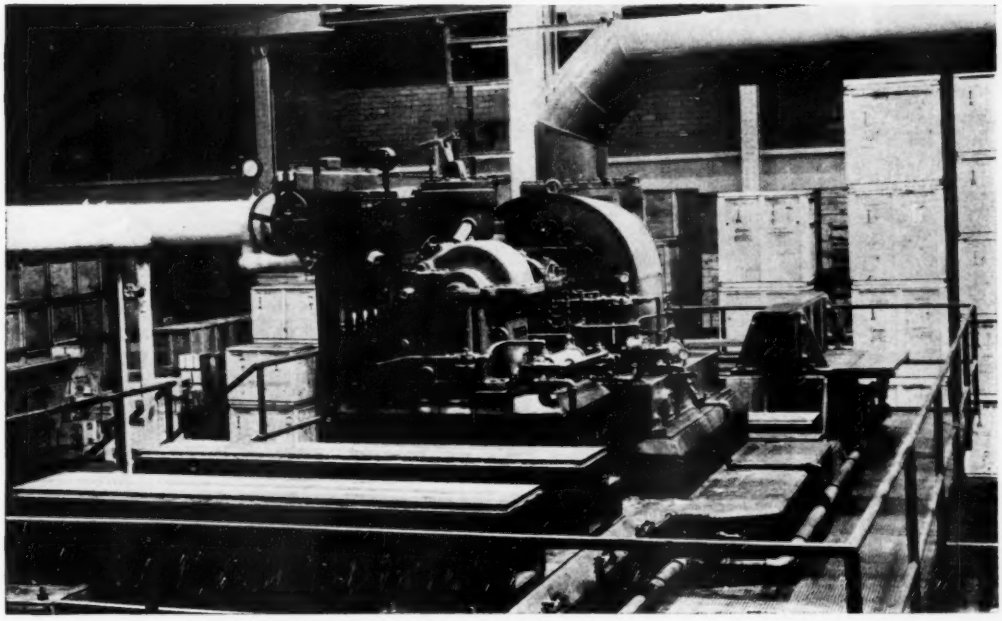
The record of 500,000 Life-Line motors in service, to date, indicates a failure rate averaging less than half that of conventional motors covered by this survey. This means over 50% indicated reduction in motor outage costs—in short, a possible saving of $480 per year with Life-Line.

Add these savings—$270 for lubrication plus $480 for outages—and the result is $750 per hundred motors per year.

Can you afford to pass up savings like these? Get the facts on the savings possible in your plant. Ask your nearby Westinghouse representative for a copy of B-4321 "How to Cut Motor Costs $750". Or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-21514

Westinghouse *Life-Line* Motors

The TERRY TURBINE



Flexible POWER and SPEED In This Test Unit

This new test stand for air- and gas-compressors at the Carrier Corporation plant in Syracuse, N. Y. meets a wide range of power requirements with a special-purpose Terry Turbine. Compressors tested may require the delivery of as much as 2500 hp at speeds as high as 14000 rpm, or the same power at 6000 rpm. This wide variation in speed was met by Terry engineers with a single 6000 rpm turbine having a double shaft extension. One extension is for direct connection to a compressor operating at not over 6000 rpm. The other extension delivers power through Terry speed-increasing gears at speeds up to 14000 rpm. The result is a compact unit that represents an economical solution to a special problem. It is typical of what Terry engineers do regularly.

Any of our district representatives will gladly give you full information on a turbine for your special purpose.

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THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

KNOCK-OUT STEAM WASTE

with Brown Flow Accounting Meters

Your costs for distribution and utilization of steam (or other fluid) will be known facts with the installation of Brown Flow Accounting Meters. Hourly and daily records from your Brown Flow Meters will enable you to know, not approximate, what is happening . . . where it is happening . . . when it is happening. You can deal a knock-out blow to waste and properly pro-rate expenses for each operation and each department. The Brown Flow Accounting System is producing sensational economies in many plants, repaying the original investment in a very short time.

Check, today, on the application of Brown Flow Accounting Meters to your processes! You can get detailed information in Bulletin 2022 . . . send for your copy!

MINNEAPOLIS-HONEYWELL REGULATOR CO.
BROWN INSTRUMENTS DIVISION
4490 Wayne Ave., Philadelphia 44, Pa.
Offices in principal cities of the United States, Canada and throughout the world

Bulletin 2022, "Brown Flow Meters for Cost Accounting," is complete and informative. A copy will be sent to you upon request. Write today!

Brown Recording Integrating Flow Meters are not expensive! For example, a complete unit for a six inch steam line costs less than $500.00!

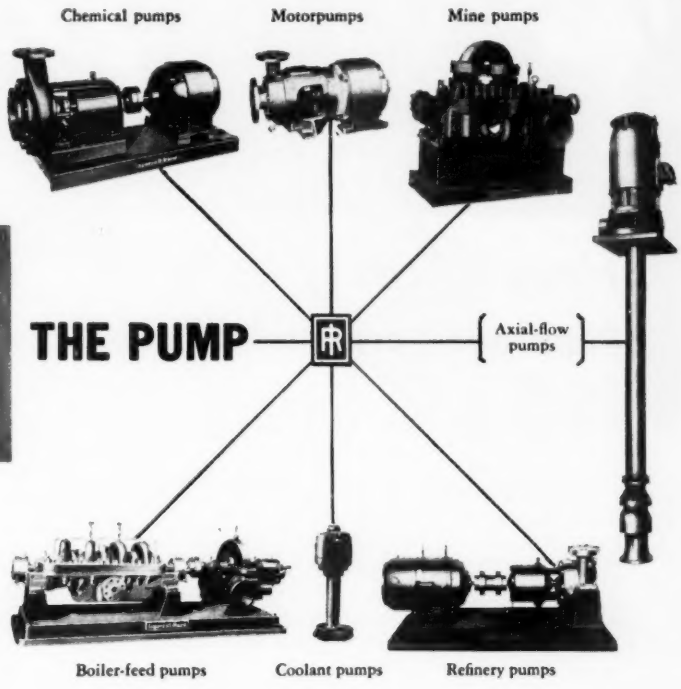
Minneapolis-Honeywell
Advanced Instrumentation
FOR BETTER PROCESSING
BROWN INSTRUMENTS

You specify

THE FLUID, TEMPERATURE, AND PRESSURE

We'll specify

THE PUMP



Ingersoll-Rand builds pumps to handle practically all liquids used by industry—fresh water, petroleum, salt water, paper stock, boiler-feed water, alkalis, acids, and many others.

There is a size and type of pump in this line to handle most any liquid-moving problem. Furthermore, new pumps have been developed as required to meet the special needs of important new industrial processes.

Ask the Ingersoll-Rand engineer to recommend pumps to meet your conditions. Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York 4, N. Y.

AIR TOOLS • ROCK DRILLS
COMPRESSORS • TURBO BLOWERS
CENTRIFUGAL PUMPS • CONDENSERS
OIL AND GAS ENGINES

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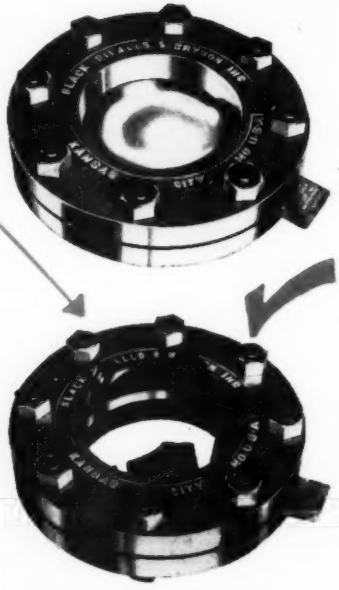
Here's Safety for Plant and Personnel with a BS&B Safety Head

The Black, Sivalls & Bryson SAFETY HEAD is a pressure relief device consisting of a pre-formed metal rupture disc, held between specially designed base and holddown flanges.

The SAFETY HEAD rupture disc bursts at predetermined pressure and temperature, affording instant, full-diameter relief. The burst rupture disc is quickly and easily replaced with a new one, and the SAFETY HEAD continues to serve you in its capacity of "watchman" over the well-being of your personnel and the security of your plant and equipment.

For further information, write to Special Products Division, Black, Sivalls & Bryson, Inc., Power & Light Bldg., Kansas City 6, Mo. Use coupon below:



BS&B SAFETY HEADS

Special Products Div., Dept. SH-6, BLACK, SIVALLS & BRYSON, INC., Power and Light Building, Kansas City 6, Missouri

I'd like full details of the BS&B Safety Heads.

☐ Please forward complete data.

☐ Arrange to have Sales Engineer call on me.

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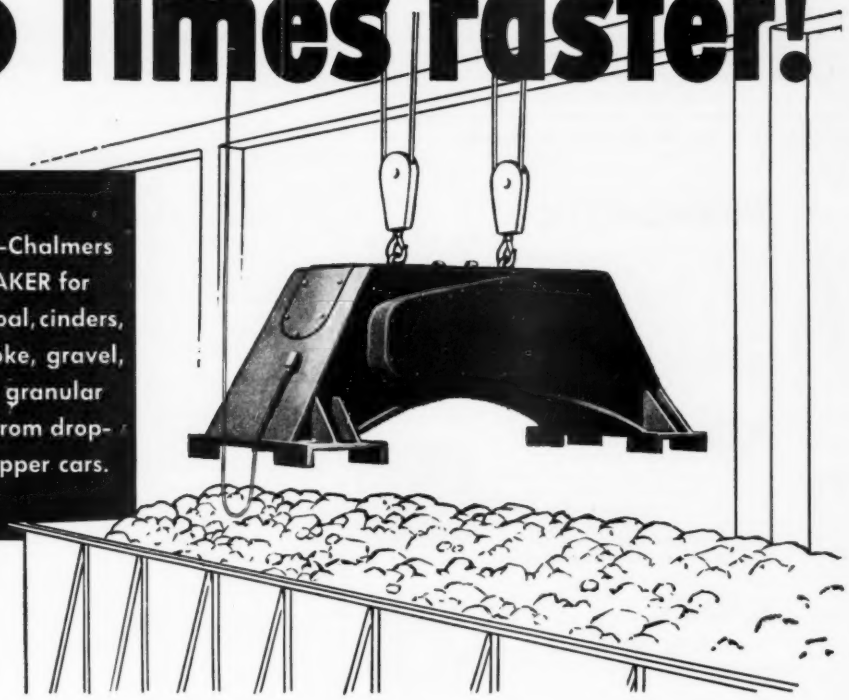
Now! Unload Coal 15 Times Faster!

New! Allis-Chalmers CAR SHAKER for unloading coal, cinders, ore, slag, coke, gravel, and other granular materials from drop-bottom hopper cars.



A TYPICAL EXAMPLE: In as little as two minutes a gondola car of 1¼ x 0 in coal screenings can be unloaded with the new Allis-Chalmers Car Shaker. Manual unloading of the same car would take up to 30 minutes!

And you save on safety! Accidents are eliminated as workmen do not have to mount the car during the automatic unloading operation. Vibratory motion of the Shaker is transmitted to the car and loosens bridged granular material so it flows freely through the hopper openings.

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For complete information on how this new Car Shaker can help *you* save time and money, contact your nearby A-C Sales Office. Or send in the handy coupon below.

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1. Motor is located inside body; drive completely covered by guard.
2. Size of body and shoes designed to fit all hopper cars operating on the North American continent.
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4. Hydraulic arrangement for bearing removal.
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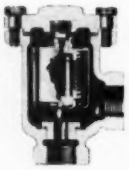
How to be Right the first time

WHEN SELECTING STEAM TRAPS

No single type of trap is suitable for all applications. But one of the four distinct Sarco types will be exactly right for any given application. Some provide quicker warm ups in the morning, some extract more of the heat, some are better for fluctuating condensate loads and others are better for out of doors. Sarco has the only plant devoted exclusively to complete lines of steam traps and temperature controls. To be sure, the first time, see Sarco first.

A THERMOSTATIC

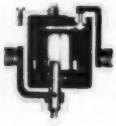


Wide open when cold for quick starts. Retains more of the heat before releasing condensate. Large valve orifice purges air quickly when starting. No seat changes when pressures change. Cannot freeze. Two types—for low pressure heating and high pressure industrial service up to 300 psi. Bulletin No. 250.

B FLOAT

Ball float allows continuous discharge without shock to temperature controls and other instruments. Automatic thermostatic by-pass takes care of air and gases without steam waste. All pressures up to 200 psi. Bulletin No. 450.

C BUCKET



Intermittent, but very rapid—can handle large volumes of condensate. Air goes out with the condensate. All parts attached to cover provide easy inspection. Straight-through connection makes installation easy. Integral strainer inside. Standard sizes to 250 psi. Forged steel types to 900 psi, and superheat. Bulletin No. 350.

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A low cost combination of trapping and approximate temperature control. Ideal for outdoor tanks and lines and other points where condensate cannot be returned. In other forms, used as combination trap and control for wash tanks, food equipment, etc. Catalog Nos. 250 and 550.

APPLICATION	1st CHOICE	2nd CHOICE
Heating Main & Riser Drips, Low Pressure, large	B	B
Heating Main & Riser Drips, Low Pressure, small	B	A
Steam Mains to Engines, Turbines or Pumps	C	C
Steam Supply Lines to Process Equipment	A	C
Steam Lines Outdoors, small	A	D
Steam Lines Outdoors, large	C	A
Tracer Lines, Outdoors	A	D
Radiators & Wall Coils	A	B
Unit Heaters, large	B	C
Unit Heaters, small	B	A
Blast Coils & Stacks	B	C
Hot Water Heaters	B	C
Storage Tanks, outdoors	A	D
Storage Tanks, indoors	B	A
Track Heaters	D	A
Kettles & Pans, small	A	C
Kettles & Pans, large	B	C

Ask for Bulletin No. 1600 "Selecting Steam Traps"

265

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Condenser Tube Problems in Power Plants

Operated by

The New York City Board of Transportation

Are more severe operating conditions affecting condenser tube life?

Are water supplies becoming more corrosive?

Will alloys which gave excellent service in the past stand up today?

Records indicate that operating conditions, in the early days, may have been less severe. Some plants had from 40 to 50% excess capacity which permitted complete shutdown of a portion of the equipment for frequent cleaning.

This situation has been changing considerably. With continued rise in power requirements it has been necessary to greatly increase the operating hours per unit. Also the high cost of shutdowns and maintenance has in some cases reduced the cleaning programs to the detriment of the tubing. Working the equipment harder, including higher water velocities, naturally accelerates the corrosion-erosion factor of tubing.

Water conditions may be improving. Growing cities and industries have been responsible for increasing water pollution with sewage and chemical wastes. Recently a serious attempt has been made to cut down pollution through treatment of factory wastes, sewage disposal plants and the use of more incinerators.

Offsetting this, the dredging of harbors and rivers and the stirring up of sediment, which had settled on the bottom, have in some cases greatly accelerated tube corrosion.

On the other hand, the quality and variety of condenser and heat exchanger tubes have never been better. Electric melting and the casting of solid billets are a big improvement over older methods of casting tube shapes. Tube extrusion and tube reducing processes have also widened the range of alloys.

Tube Performance Recorded

The effect of changing conditions is illustrated in the study of condenser tube performance at three large power plants operated by the New York City Board of Transportation.

All have different water conditions which in recent years are somewhat improved as far as contamination from raw sewage is concerned. Nevertheless, condenser tube alloys which were satisfactory years ago do not stand up as well as formerly.

During the period 1914 to 1926, Admiralty metal tubes gave satisfactory life in the large condensers at the 74th Street and 59th Street Power Plants. Rubber plugs, shot through the condenser tubes with compressed air, were used extensively for the cleaning of tubes. Cleaning was done between peak loads when a turbine unit was out of service. Dezincification was then the main cause of tube failure.

At the Kent Avenue Power Plant, Admiralty tubing lasted from two to three years only. Due to this short service Aluminum Brass tubes were first introduced years before they were made standard at the other plants.

Original installation of Admiralty tubes in 1914 in a large condenser at the 74th Street Power Plant were replaced in the lower half in 1926 and in the upper half in 1927. This represents a service life of 12 to 13 years. However, between 1925 and 1941 Admiralty replacement tubes served about five or six years and in some cases much less.

The Admiralty tubing at the 59th Street Power Plant gave a slightly longer service life. During the 1941-1946 period Aluminum Brass was the standard alloy for both the 74th Street and 59th Street Power Plants. This was followed by Aluminum Bronze (95% copper, 5% aluminum) in 1946.

Aluminum Bronze has recently been placed in service at the Kent Avenue Plant. It has not been in long enough to determine its life expectancy.

Slime Removal and Cleaning

The importance of maintaining a high vacuum is recognized and various methods are used to control slime. At the 59th Street and Kent Avenue Power Plants, a chlorination process (chlorine) is used while at the 74th Street Power Plant a sodium hypochlorite solution containing not less than 140 grams per liter of available chlorine is injected into the circulating water inlet line.

Experience Helpful

We hope that this study of changing conditions with resulting changes in alloy requirements will be helpful to operating engineers. Our laboratory will be glad to cooperate in connection with supplying information on condenser tube alloys — their properties and applications.

The New York City Board of Transportation

No. of Turbines	Capacity KW	Area Sq. Ft. per Condenser	Number of Condensers	Type of Condenser
		59th Street Station		
3	35,000	50,000	3	two-pass
5	7,500	25,000	3	two-pass*
1 (being built)	62,500	60,000	1	
		74th Street Station		
3	30,000	25,000	6	two-pass
1	60,000	25,000	4	—
1	7,500	80,040	1	three-pass (two per unit)
		Kent Ave., Brooklyn		
2	7,500	25,000	2	three-pass
1	7,500	25,000	1	two-pass
1	30,000	40,000	1	two-pass
4	10,000	20,000	4	two-pass
1	20,000	25,000	1	two-pass
2	35,000	50,000	2	two-pass

*Each turbine operated by exhaust steam of a double-angle compound engine.

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Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

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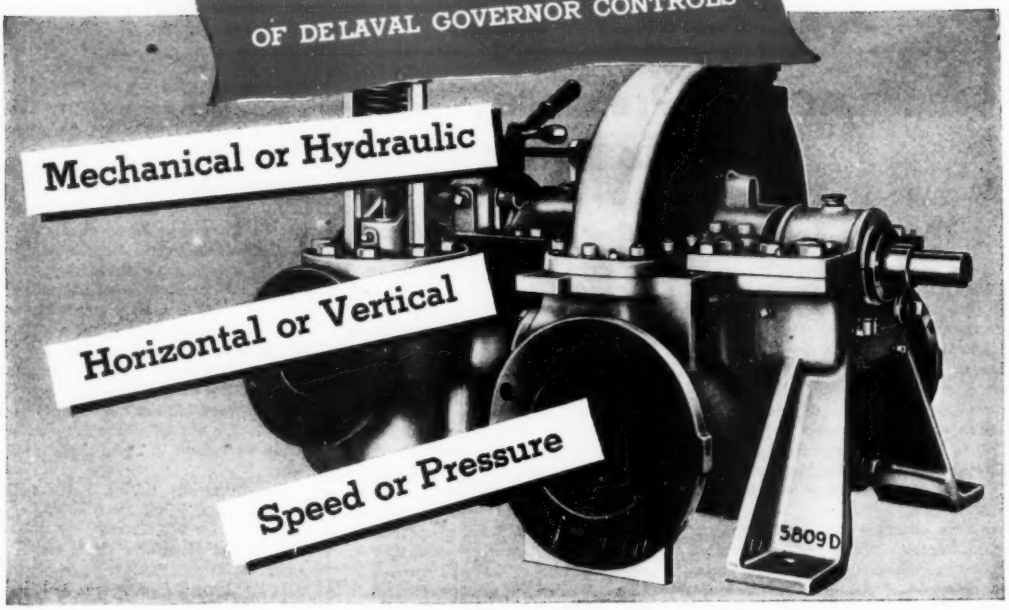

Whatever your control requirements, De Laval Class CA Turbines can be equipped with a governor that will meet the demand. The following types are available:

1. *Mechanical shaft governor* with smooth-acting, long-wearing "rocking chair" action.
2. *Vertical mechanical governor* geared to shaft for speeds above 4500 rpm.
3. *Hydraulic governor.* Direct acting orifice-type for high speeds and/or wide range of speed adjustment.
4. *Hydraulic oil relay* for close regulation or for supplying extra power for valve movement.
5. *Flyweight oil relay* for close regulation such as encountered in synchronous generator drives.
6. *Pressure controls* for constant pressure or differential pressure regulation of pumps, blowers, etc.
7. *Speed changers,* manual or remote control by electric motor drive with vertical mechanical governor.
8. *Oil pressure trip* to shut off steam if oil pressure falls in turbines equipped with forced feed lubrication.

Combinations of the above types can be supplied as required to meet specialized conditions.

Before you buy a turbine, be sure and get complete information on these additional De Laval features:

- ✔ True center line support and flexible mounting for perfect alignment.
- ✔ Balanced double-seated bonnet-type governor valves for close control of steam flow.
- ✔ *Positive* over-speed protection entirely separate from normal speed governor for unfailing emergency shut-off.
- ✔ Super-smooth, chrome plated shaft journals make carbon rings last longer.
- ✔ Casing and bearings split horizontally at center line for easy removal and inspection of the rotor, carbon rings and bearings.

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POWER

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STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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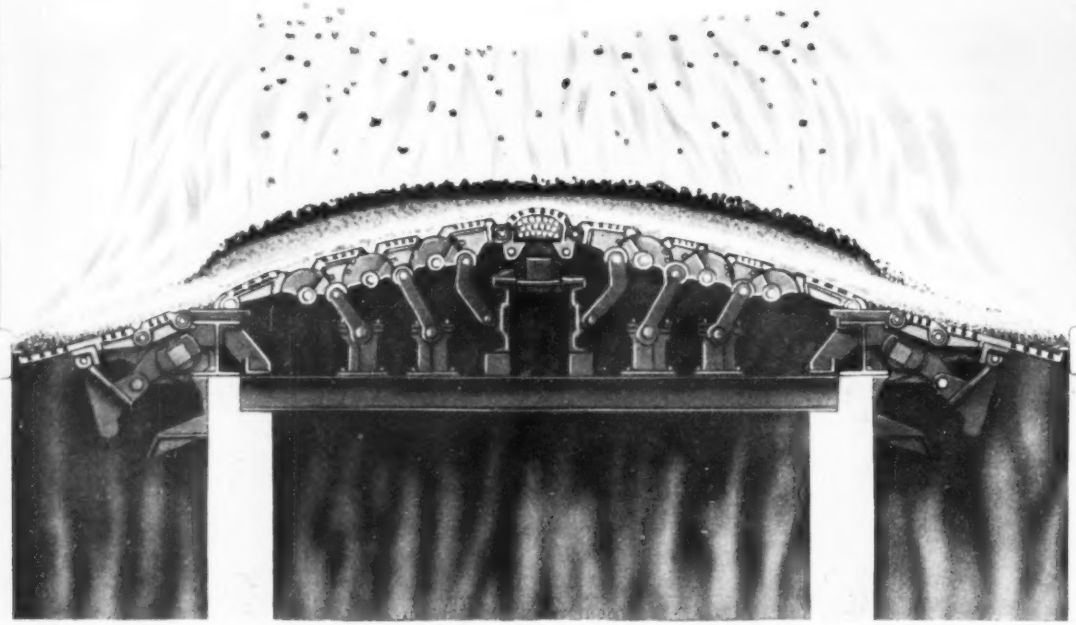
with *Link-Grate*



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A generous part of the fuel burns in suspension. The remainder thoroughly burns on a porous, inclined fuel bed. Burning fuel and accumulating refuse progress constantly toward the ash-discharge grates along the side walls.

The drive is simple, rugged and trouble-free . . . one motor or turbine operates all moving parts through a constant-speed oil pump.

The Centrafire with Link-Grate may readily be applied to the boiler of your choice within the base-load capacity range of 25,000 to upwards of 50,000 lbs. of steam per hour.

The Centrafire is backed by over 60 years of Westinghouse fuel burning know-how and a nationwide service organization eager to see that you get optimum operating economy from your Westinghouse firing equipment.

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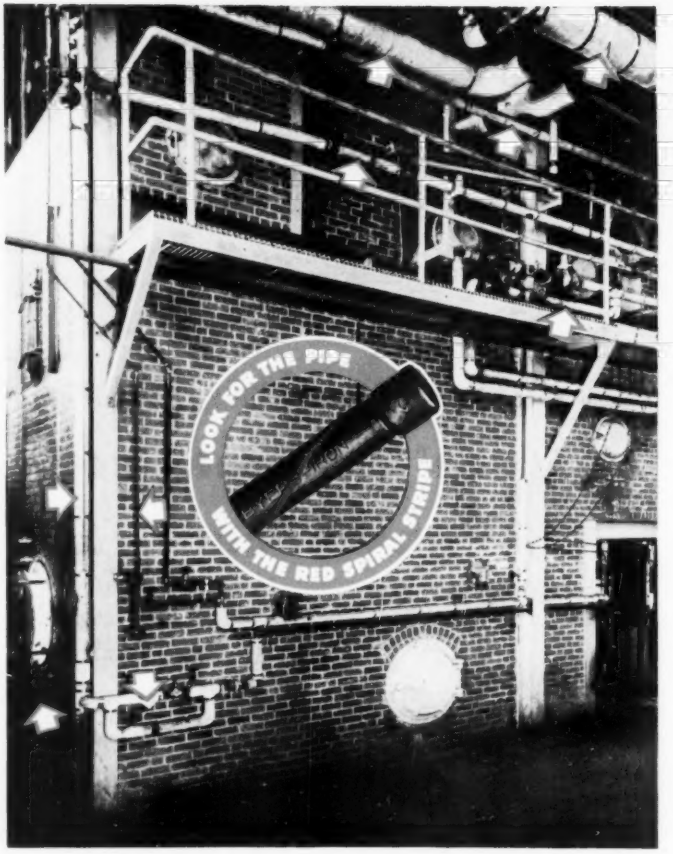
IN THIS

NAVAL AIR STATION

POWER PLANT



The new power plant at the Naval Air Station, Squantum, Massachusetts, reflects the "build to last" standards of the Navy Department Bureau of Yards and Docks. In ten services where corrosion was a known or potential hazard, Byers Wrought Iron pipe was used. The applications included main steam header; main steam distribution lines; condensate return circulating lines; boiler feed lines; feed water regulator lines; fresh water make-up lines; drip lines; water column lines; steam lines for atomizer; and oil lines. Pipe sizes ranged from ¾-inches to 8-inches.

Almost every piping service in a power plant carries some threat of corrosion, and in many instances the only assured protection is through the use of a material with demonstrated ability to resist the attack. Wrought iron has established some excellent records for dependability in plants all over the country, and any engineer who is looking for lowest cost per year in his installation piping will find it profitable to investigate the material.

Wrought iron's durability comes directly from its unique composition and structure. The tiny fibers of glass-like silicate slag that are threaded through the body of high-purity iron halt and disperse corrosive attack. This discourages the pitting and penetration that generally cause low-first-cost materials to fail. Furthermore, the fibers anchor the initial protective scale which shields the underlying metal.

If you are concerned today with the construction, replacement, or repair of any boiler plant services, you will find some helpful information in our bulletin, WROUGHT IRON FOR PIPING SYSTEMS. It discusses the various corrosive conditions encountered, and reports the experiences of engineers in combating them. Ask for a complimentary copy.

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

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GENUINE WROUGHT IRON

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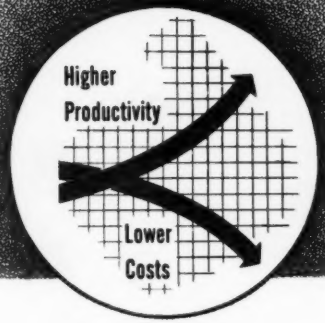
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



How to Save Power Dollars

THIS MONTH the many McGraw-Hill technical and business publications join hands in a unique project. Each will publish a special section on the general theme of higher productivity and lower costs, but addressed to the particular practical needs of its special reader group.

We are happy to play our part in this cooperative venture. We know that higher productivity and lower costs are the keys to American prosperity. And we know that our power services vitally affect production and costs all the way from farm, forest and mine—through factory, transportation and service industries—right down to the home of the ultimate consumer.

Of course, showing readers how to save power dollars is not some new type of publishing service. Mainly that's what our articles talk about every month, year after year.

This makes it possible for us to bundle up a great number of these ideas in this 16-page section. You will find here a short article on each of the power services. In each article you will find a check list of ways in which you can save money in the generation, transmission and application of a given service. Not all the suggestions will fit your plant, but many will.

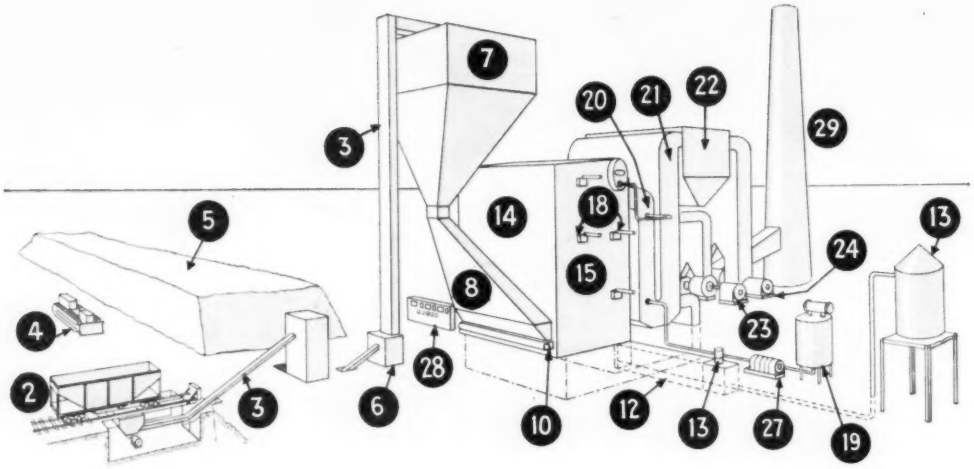
Some attention is given to equipment selection, arrangement and hookup, but more to the kind of savings the engineer can make every day in his operating rounds. These are of many different kinds. He may use less fuel in his boiler plant, or burn a cheaper fuel. Here his saving is direct. He may make indirect savings by installing dust-removal equipment to protect the factory product from damage and to protect the good name of the company in the community. Again, he may save power dollars directly by reducing the power consumption of refrigerating equipment and air compressors, or by eliminating many wastes in transmission and application.

Now and then the reader will be puzzled by suggestions that concern quality of service, but don't seem to save any dollars for the power department, may even increase them.

Here the point to remember is that your higher costs may be necessary to build big savings for some other department. After all, the man in charge of power must view his job broadly. The quality of his services affects the efficiency of every other department.

We hope every reader will check through these lists and will find ways to cut the unit costs of his power services, reduce waste in their transmission and application, and improve the quality and dependability of his services.

In these ways he will be doing his share to increase the national productivity and to cut the costs of all manufactured goods and services to the end that every American pay envelope will buy a better standard of living.



Steam Generation

► IN THE MAIN, the suggestions that follow are concerned with keeping down the cost of steam, chiefly by reducing the total number of dollars spent for fuel and other operating expenses. Yet this is by no means the whole story. It often happens that blunders in plant design or operation limit plant capacity so it is impossible to carry the load without adding equipment or switching to a more costly fuel. Preventing such unfortunate occurrences requires foresight that must start back in the designer's office.

Yet our main concern here is with operation. Generally speaking, the major operating savings in steam generation must be made by (1) burning a fuel costing less per million Btu and (2) consuming less fuel energy. The first is a matter of fuel selection, the second mainly a matter of complete combustion with minimum excess air, plus clean heat-transfer surfaces, tight boiler settings and tight baffles.

Within the limitations set by the plant designer, the operator is doing a good job if he maintains reliable service, avoids excessive labor and maintenance costs, burns a "bargain fuel" (one with low cost per million Btu) and comes fairly close to test efficiency.

1 FUEL FLEXIBILITY. Wise designers and wise owners agree that fuel flexibility must be built into the plant and is well worth what it costs. That means that all fuel-handling and ash-handling equipment, all firing equipment, furnaces, draft fans, stacks, etc. must be large enough to carry full load steadily with any fuel likely to be economically available in the region. Then the operator can take advantage of fuel bargains as they occur.

1A COAL PURCHASING. Select the coal that will carry your peak load reliably with the lowest over-all cost. If your plant is designed with ample capacity in all parts, that is likely to be the coal with the lowest delivered cost per million Btu. With cheap coal, however, allowances must be made for somewhat lower efficiency, greater pulverizing cost and somewhat greater coal- and ash-handling costs.

2 COAL RECEIVING. How much labor does present coal unloading and handling require? Would mechanization help? Would labor saving, improved employe morale and greater operating reliability warrant installing car shakers and dumpers and coal-thawing sheds?

3 CONVEYING SYSTEMS. When you install conveyors look ahead. Some day you may wish to handle more tons of lower-grade coal. Enlarging the system then will cost you more than making it big enough in the first place.

4 COAL-STORAGE HANDLING. Are you using the most efficient methods? Will bulldozer, carryall or drag scraper speed your coal handling and reduce your labor cost per ton moved?

5 COAL STORAGE. Pack the coal properly to exclude air circulation. Install thermocouples to detect any temperature rise in body of pile before costly fires start by spontaneous combustion.

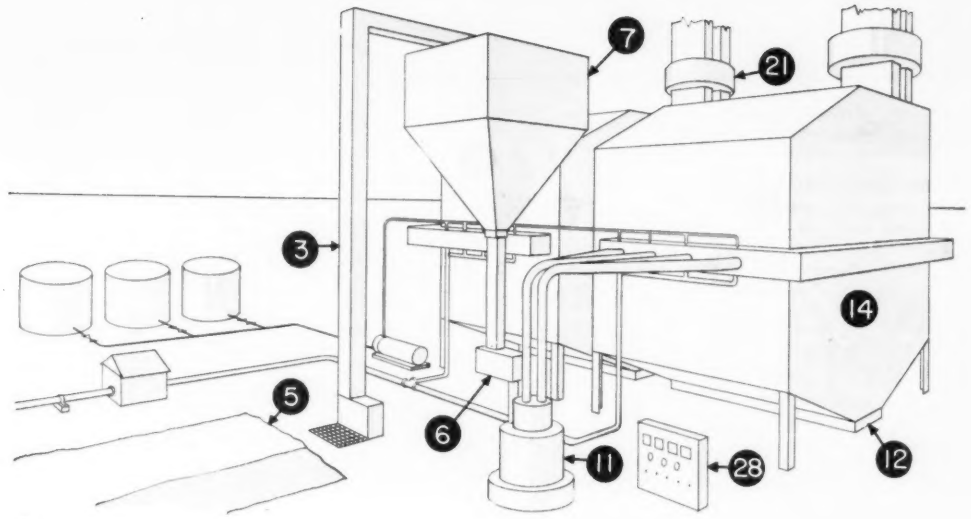
6 WEIGH COAL. Coal is your biggest operating cost. Weigh all coal consumed and keep daily or continuous records. Check actual daily performance against guarantee or test, allowing for variations in load, banking periods, starts, coal quality and air temperature.

7 COAL BUNKERS. Make sure all coal passes through bunkers. Avoid dead pockets that might lead to spontaneous ignition. Prevent coal from freezing by steam coils or by enclosing bunker. Provide poke holes near discharge gate to break up coal arching.

8 COAL CHUTES. In stoker firing use type of chutes that will spread the coal evenly across the stoker front, without segregation. This improves efficiency.

9 HAND FIRING. With today's high labor and fuel costs, hand firing is obsolete everywhere—even in the home.

10 STOKERS. Keep fire even and free from holes, to avoid excess air



(low CO_2) over thin spots. In large units, zone control of air supply to fuel bed may help. Avoid rush of excess air up through air at the dump end of stoker. Also avoid heavy loss of carbon to ashpit. Buy stoker large enough to handle load with any coal likely to be economically available.

11 PULVERIZERS. Buy pulverizer and motor big enough to carry full load on coal of the lowest grindability likely to be used.

12 ASH HOPPERS AND SLUICES. Make sure hoppers don't leak air into furnaces. Design system for a clean plant and minimum handling labor.

13 ASH SILOS. Many small plants find it best to blow ash to a silo and discharge from silo to truck—a cheap and reliable system.

14 TIGHT SETTING. Excess air is the biggest combustion waste. Keep setting tight.

15 FURNACES. Furnaces should be large enough, and so shaped that combustion is complete before gases contact convection heating surface. This makes for best efficiency and minimum smoke.

16 BAFFLES. Don't let leaky baffles bypass gases around part of heating surface. This reduces heat absorption in the boiler.

17 REFRACTORIES. In buying refractories and arches, consider the cost of incomplete combustion—also the repair cost resulting from improper materials or suspensions.

18 SOOT BLOWERS. To insure soot-free tubes and low-cost soot removal, install good mechanical soot blowers.

19 FEEDWATER TREATMENT. Partly to save fuel, but more to save the boiler, keep tubes and drums free from scale by proper external or internal water treatment.

20 ECONOMIZERS. The economizer permits higher efficiency. Watch soot deposits, corrosion and scale to make sure high maintenance cost doesn't offset some of the fuel-saving advantages.

21 AIR HEATER. Same comments as for 20, economizers. Test carefully to see how far flue-gas temperature can be lowered without excessive maintenance costs from condensation of moisture in flue gas.

22 DUST COLLECTORS. Dollar savings from flyash collection are indirect but important—good will, clean plant, clean product, improved worker morale.

23 FORCED-DRAFT FANS. Be sure it's big enough to handle any fuel and load that may be encountered. Consider power savings by variable-speed drive or by hydraulic couplings.

24 INDUCED-DRAFT FANS. Same as for forced-draft, but consider also designing to handle hot dusty gases with lowest maintenance requirements.

25 BLOWDOWN. Blow enough to get rid of sludge but not to waste heat. Consider whether it would pay to install continuous blowdown with heat recovery.

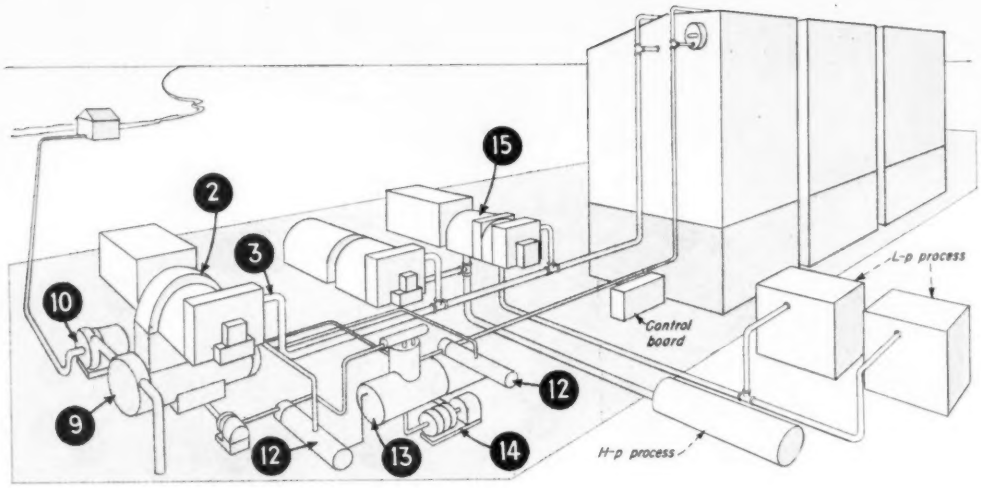
26 SAFETY VALVES. Make sure they will blow when needed but not often—and that they don't "simmer" in regular operation.

27 FEED PUMPS. In some industrials, with heavy demand for heating and process steam, "steam-eating" duplex feed pumps involve no dollar waste, but most plants can save a lot by electric drive of pumps. Use automatic feedwater control for smoother and better operation.

28 INSTRUMENTS. These are essential for efficiency. At the minimum you should weigh coal, measure flue-gas temperature and CO_2, draft, feedwater temperature, steam temperature and pressure—also measure feedwater or steam, or both.

29 STACK. Make it high enough to keep smoke and dust out of the neighbor's eyes. Where there is no induced-draft fan make stack high enough for balanced draft in furnace.

30 HEAT INSULATION. Insulate all hot surfaces, hot-water lines, steam lines, fuel drums, settings, heaters, breechings, etc. to save fuel dollars. It will also keep the room cool enough to attract efficient operators and keep them mentally alert.



Power Generation by Steam Engines

► THIS ARTICLE is concerned only with the turbine room and with the engine room—with the equipment used to expand steam and convert part of its available energy into mechanical and electrical power. It lists various ways to save dollars, both directly and indirectly, and to insure meeting the peak demands.

Efficiency of the turbine room is largely built in by the designer, so there is less chance for the operator to make a showing than there would be in the boiler room. Just the same, the difference between good and bad turbine-room or engine-room operation can mean a lot of money.

The attentive operator can save by loading his units according to a scientific schedule, by keeping his condensers clean and free from leaks, by checking turbine performance for signs of falling efficiency indicating blade wear or fouling, by checking engines for faulty valve adjustment or steam leaks past pistons and valves.

Good housekeeping and scientific maintenance have a vital bearing on costs. First, they are insurance against disastrous shutdowns with resulting loss of production or customer good will. Then they reduce overtime repair work and the cost of elaborate repairs. The only good maintenance is "preventive maintenance" based on a regular schedule of inspection, cleaning and overhaul. The smart engineer fixes equipment before it breaks.

The industrial power engineer must never forget the great savings often made possible by byproduct power generation. The basic idea is to eliminate as far as possible the waste of exhaust heat to atmosphere or condenser.

In the rare ideal case all power is generated by turbines or engines exhausting and bleeding low-pressure steam for space heating and for process, with no steam wasting to atmosphere or to condenser. Where space heating and process cannot absorb all the exhaust and bled steam, remedies may include higher throttle pressures and temperatures and more efficient generating units. These will reduce the steam exhausted to carry a given electric load.

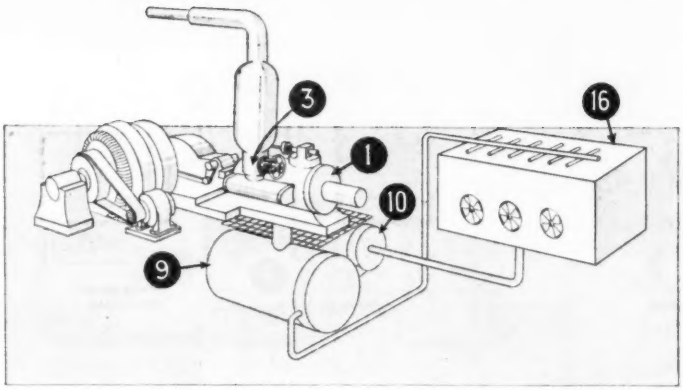
Where steam must still be wasted it is less wasteful to expand it to vacuum before discharging. Thus, a condensing turbine bleeding to process at several levels is often the most economical arrangement, possibly paralleled with an additional turbine exhausting directly to process.

1 STEAM ENGINES. Take indicator diagrams from time to time to check valve timing. Keep piston rod and valve packings in good shape to prevent shafts scoring by excessive leakage. Drain steam and exhaust chest thoroughly before starting. Make sure all rubbing parts are well lubricated. Check steam rate from time to time to reveal leakage of steam past piston or valves. If possible, use exhaust for heating or process.

2 TURBINES. Follow starting procedure specified by manufacturers to avoid costly shutdown or damage. Improper starting procedure may expand rotor and casing unequally and damage seal strips and glands—in extreme cases, even destroy blades by rubbing. Make sure casing is thoroughly drained; leave drains open until unit is under load. Keep lube-oil pressure and flow at rated levels during starting, load and stopping phases.

3 STEAM CONDITIONS. Too low pressure and temperature reduce efficiency. Too high endanger equipment. In particular, metal may fail if design temperature is exceeded. Excess pressure may damage turbine stage diaphragms and blade seals. To minimize expansion differentials keep temperature changes within specified limits. If an old unit, with many years of remaining life, has trouble with moisture erosion in last stages investigate cost of replacing blades with modern shielded ones.

4 GOVERNING. Check turbine governor before starting; see that it takes control at proper governor speed. Occasionally inspect governor-spring-tension motor; see that stops are properly located to prevent overloading unit, yet take full advantage of unit capacity.



And Turbines

5 EMERGENCY DEVICES. Always check throttle tripping mechanism during starting and stopping, and note speed at which stop valve shuts off steam flow. If overspeed exceeds 10% of rated speed take immediate steps to locate and repair the cause of sluggish operation.

6 LUBRICATING SYSTEM. Keep oil in tiptop shape by periodic microscopic and chemical examination. Filter and centrifuge the oil, or replace it as needed. Oil leaks are a prime fire hazard: fix them immediately. Perhaps you can cut your insurance premiums by redesigning the lube system. When the turbine is running at normal load test the auxiliary oil pump now and then to make sure it will start automatically if needed. Watch oil temperature or provide a thermostatic alarm to save yourself the grief of prolonged outages.

7 INSTRUMENTS. Intelligent operation is impossible without enough instruments of the right kind. These should include wattmeter, watthourmeter, steam or condensate meters, pressure and vacuum gages, thermometers, tachometers. In addition, large units often require meters for shaft eccentricity, bearing vibration and cylinder axial expansion.

Log the data from these instruments often enough to have a representative record of operation. Analyze records at least once a week. Compare actual performance with test or guaranteed performance, allowing for variations in loading, steam pressure and temperature, backpressure, extraction and bleed flow. When steam rate and heat rate deviate from normal look for the cause. First check the instruments; then look for mechanical trouble.

8 BLADE DEPOSITS. Fouling of blades from steam carryover lowers the overall efficiency of the unit. Fouling is indicated by a falling off of the power the unit delivers with governor valves wide open—also by rising stage pressures (for given loads). Best cleaning method varies from plant to plant and must be determined by experiment. The period between cleanings should be such that the yearly cleaning cost, plus the yearly fuel loss due to fouling, is a minimum.

8A INSPECTION. If at all possible, dismantle machines for inspection after every 10,000 operating hours, or after 20,000 hours at the outside. This is the only way to catch incipient troubles before they become disastrous. To insure early restoration of service, outline your inspection program minutely, study records of previous inspections, have all tools, replacement parts ready when unit comes off the line.

9 MAIN CONDENSER. See that all joints remain tight to produce maximum vacuum. Keep tube surfaces clean by plugging, chlorination, or whatever method proves economical. Watch condensate salinity closely to check tube leakage. Check condenser performance regularly.

10 CIRCULATING-WATER PUMPS. With variable-speed drives make careful study to find most economical speed for each combination of turbine load and cooling-water temperature. It doesn't always pay to run pumps at top speeds because their extra power consumption may exceed additional kilowatts generated because of the better vacuum.

11 AIR EJECTOR. Keep steam flow down to needed minimum. If ammonia is entrained in ejector condensate, reject water to sewer. For high-pressure steam installation, investigate vacuum pump to avoid high steam-reducing-valve maintenance.

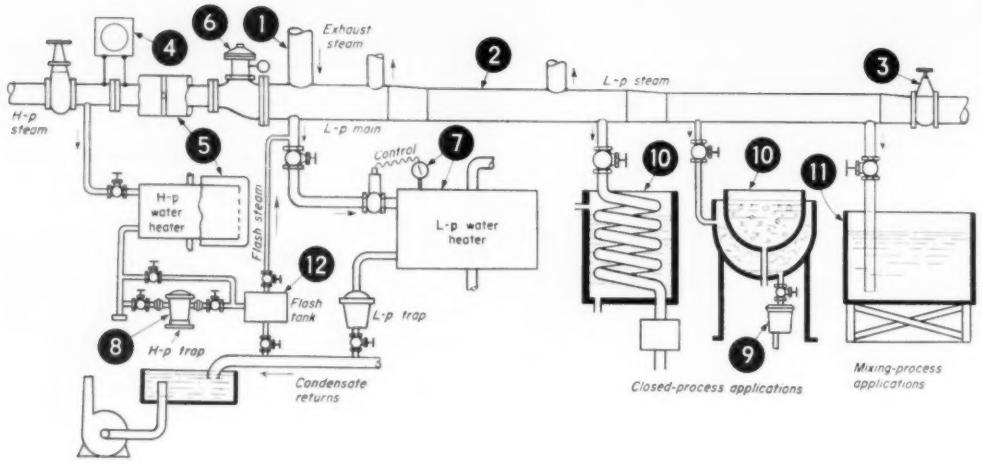
12 HEATERS. Vent all noncondensable gases so heaters will work at full capacity. Check heater performance periodically to detect fouling and leakage. Chemical cleaning is usually the most effective.

13 EVAPORATORS. See that evaporator preheater vents its non-condensable gases. Don't prolong operation beyond that needed to keep storage tank full. If two evaporators are available study economy of double-effect operation. Clean tubes to keep up evaporating capacity.

14 FEEDWATER PUMPS. In high-pressure stations make continuing study of pump materials to find those with longest life for existing conditions. For extended medium- and low-load operation provide variable-speed drive.

15 EXTRACTION TURBINES. Keep steam flow to condenser as small as possible. When low-pressure steam demand exceeds that available from low-pressure extraction point, bypass excess from boiler through reducing valve. Don't alter turbine throttle steam conditions. See that governing system functions as designed. If a considerable number of excess kilowatt-hours are available from backpressure generation see if it can be sold as dump power to local utility. Mutual interchange of energy may help to reduce plant investment, increasing over-all financial efficiency.

16 COOLING TOWER. Inspect periodically for fouling. Treat makeup water to kill algae. For greater capacity on natural-draft unit consider installing fans.



Steam Distribution And Application

► OTHER ARTICLES have listed ways to save money in steam power generation and in heating. This page is concerned with the savings and improvements that can be made in the distribution and application of process steam.

Here, as elsewhere in this section, the cost angle will not be confined to the cost of producing and delivering the process steam. Nothing is gained, for example, by a reduction in the cost of steam supplied to a process if it is more than offset by lowered output and quality of manufactured product. The engineer must look at the whole picture.

So these suggestions will show how to use the cheapest available steam, how to prevent its waste in transmission and application, and also how to make certain all process equipment operates at top effectiveness.

1 CHEAP HEAT. Don't use live steam when exhaust of engines or pumps will do the work. If engines and pumps discharge more exhaust than process requires consider electric drive for pumps. Also consider cutting engine steam rate by higher throttle pressure, lower exhaust pressure or more efficient units.

2 PIPING. Too small piping will stifle process-steam supply. Too large piping will waste investment money and increase heat loss. Hit the happy mean.

3 VALVES. Fix or replace leaky valves. Above all, seek out and stop hidden leaks to dead piping or concealed discharge points.

4 METERS. Meter total process steam. To discourage waste, also meter and charge consumption of major departments.

5 INSULATION. Cover all piping and tanks containing steam or hot water with good insulation, amply thick. Manufacturers' catalogs give application instructions and economic thicknesses.

6 REDUCING VALVES. For steam economy and process efficiency make sure reducing valves hold pressure constant at lowest pressure that will insure full production and sound product.

7 WATER HEATING. See page on water services for dollar importance of thermostatic control to hold water at proper temperature. Too hot or too cold water makes for waste.

8 TRAP-INSTALLATION TIPS. Get trap big enough to handle initial rush of condensate when steam is turned into cold equipment. Locate trap for easy access so operator can conveniently check operation and remove trap for inspection and repair.

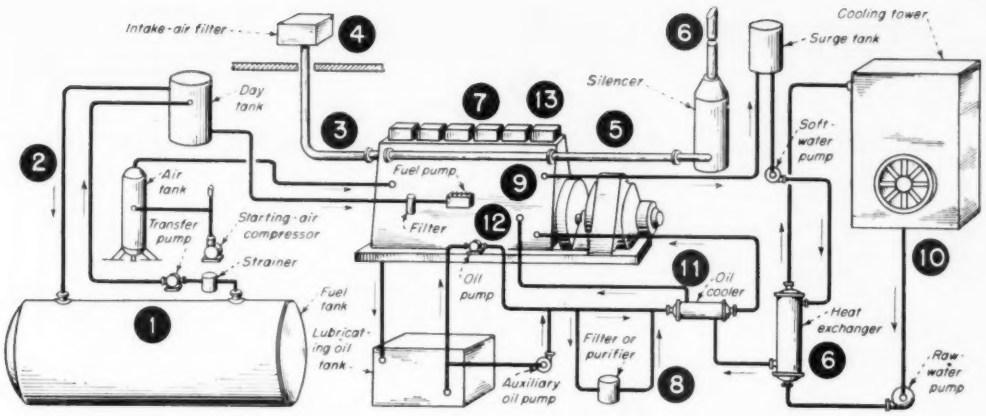
9 TRAP OPERATION. Trap in good order will completely remove condensate from equipment, but won't blow steam. It will also vent air entrained in the condensate. Most process equipment will require an additional high vent to remove air accumulation when operation starts. Air-bound equipment won't heat properly. Air affects production and quality.

10 CLOSED PROCESS APPLICATION. In equipment of this type make sure trap discharges water and air, but does not blow steam to waste.

11 STEAM MIXING PROCESS. If the operator opens the valve wide, much steam may bubble to waste through the tank. Curb this waste by orifices or other flow-limiting devices.

12 FLASH TANK. If the condensate leaving high-pressure process equipment is hotter than 212 F, consider installing a flash tank after trap so flashed steam can be piped into the low-pressure main.

13 CONDENSATE POINTERS. Wasted condensate is wasted water and wasted heat. Get condensate back to the boiler room with as little temperature fall as possible.



Diesels, Gas Engines

► MODERN DIESEL AND GAS ENGINES have high efficiency built into them. Thus cutting costs in this kind of a power operation consists largely in operating and maintaining your plant to keep it at peak performance. Here are pointers:

1 FUEL. In many parts of the country, gas is now relatively cheap. For a new plant, consider installing a dual-fuel engine to burn gas on the high-efficiency diesel cycle. Since such engines can be switched from gas to oil fuel under load, they also fit in well where cheap gas is available only part of the time. Sewage plants form an example. Some existing oil diesels can be converted to gas operation without major changes. Look into this possibility if you can get cheap gas. Also check into possible use of heavy oil—in some plants, with large low-speed engines, heavy oil produces net savings.

2 FUEL HANDLING. Protect against impurities found in both liquid and gas fuels with adequate strainers and filters. Heavy, low-grade fuels should be centrifuged and preheated; insulate lines so excessive heating isn't needed to deliver oil to injection pumps at proper temperature.

3 SUPERCHARGING. Supercharged engines produce over-all plant savings in first cost of cooling system, foundations, buildings, etc. Also, they are apt to be somewhat more economical of fuel. Be sure to consider these angles in planning a new plant. Existing engines can frequently be supercharged; cost of capacity added in this way is often less than new engines.

4 AIR INTAKES. An ample supply of clean air is essential for combustion; lack of air reduces capacity. Check piping for excessive pressure drop. Eliminate bends and fittings, shorten piping runs where possible. Use largest economical pipe diameter. Avoid preheating of intake air. Check pressure drop across filters to guide cleaning.

5 EXHAUST SYSTEMS. High backpressure reduces amount of expansion on power stroke and prevents maximum air intake on suction stroke. Keep it as much below 2 psi as possible.

6 HEAT RECOVERY. If you can use hot water or low-pressure steam don't overlook possibilities of recovering heat from jackets and exhaust. This may mean savings in boiler-room equipment and labor, as well as in fuel.

7 COMBUSTION. Make sure compression pressure is right. Keep nozzles clean, spray valves tight. Use exhaust pyrometers to balance load on cylinders. Remember that the work is done in the combustion space—see that it's done right.

8 LUBRICATION. Long engine life depends on good lubrication. Oil filters and purifiers remove contamination occurring in oil under service conditions, protect the engine, and give you more "mileage" from the oil.

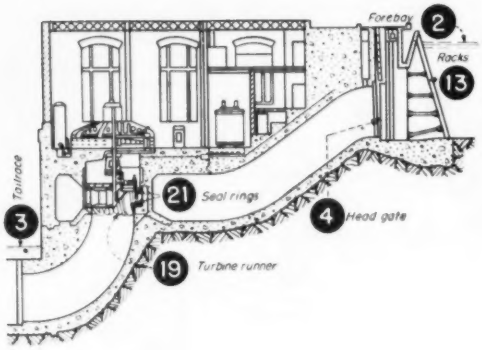
9 JACKET TEMPERATURE. Hold to range recommended by engine builder. Regulate flow to keep temperature rise to 10-20 F. This makes turbulence in water spaces, prevents local hot spots and decreases temperature difference between top and bottom of cylinders. Low jacket temperatures may cause incomplete combustion and condensation on lower cylinder walls. This latter is a common cause of liner wear, particularly with fuels containing hydrogen sulphide.

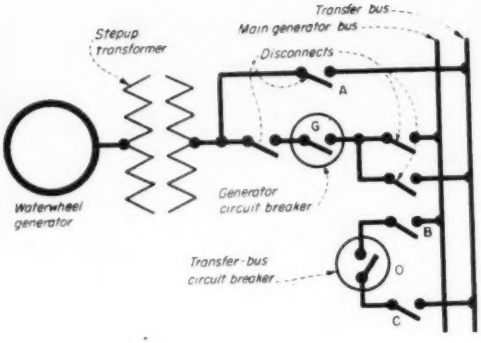
10 COOLING WATER. In some areas, particularly large cities, cost of cooling water may be a substantial item. Evaporative cooling—by cooling tower, evaporative condenser, spray pond, etc—eliminates about 95% of water consumption, cuts cost.

11 OIL COOLER. Keep oil at proper temperature (usually shouldn't exceed 150 F). High temperature tends to increase leakage from crankcase, speeds oxidation and sludge formation.

12 OIL PRESSURE. Lubrication failure may mean bearing or piston seizure, costly repairs. Look into pressure changes immediately. Increased pressure usually means clogging. Slow fall of pressure usually indicates bearing or pump wear. Watch for sudden drop—that's usually a burned-out bearing. Blue smoke in exhaust indicates excessive oil; adjust oil pressure or rate of cylinder feed. If oil feed is right, check for faulty piston rings or other mechanical defects.

13 VALVES. Getting the air in and the exhaust out at the right time is a vital part of efficient combustion. Grind valves regularly; check timing.





Water Power

► OPERATING COSTS of hydroelectric plants are so low that there are fewer opportunities to cut expenses than in steam plants. Moreover, the efficiency of hydro units is high, and remains fairly constant at a given load, no matter how the plant is operated. This is not so in steam stations. The greatest opportunities for lowered unit cost in hydro-plant operation are to increase the kilowatt-hours obtained from the available water. Operating conditions vary so widely between different plants that some of the suggestions here given have only limited applications and should be so considered.

1 OPERATING PROGRAM. Set up an operating program to use the available water most efficiently.

2 WATER LEVEL. Where possible maintain highest water level in forebay. Normally this will generate maximum kilowatt-hours from a given water flow.

3 RECORDERS. Install recording forebay and tailrace-level recorders to guide operator in loading the plant.

4 GATES AND VALVES. Have intake and draft-tube gates and penstock valves full open to keep head loss as low as possible.

5 PLANT LOADING. When load decreases on the plant, near the end of normal operation, as at night, or on holidays and weekends, increase plant load to pull down forebay level to provide storage for water that will not be able to pass through the plant during low-load period.

6 DUMP POWER. Where large storage is available, sometimes it pays to conserve water by buying dump power from another system to supply part of the load.

7 RAINFALL RECORDS. From rainfall and snow records try to predict amount of spring flood that will be available for storage. Then lower reservoir level to store this water.

8 ELECTRIC BOILERS. In some localities, installation of electric steam boilers in industrial and other plants has proved profitable to use dump power generated from flood water and during low-load periods.

9 STEAM STATIONS. Where run-of-river plants operate in parallel with steam stations, carry as much load as possible on hydro during flood periods, but only peak loads during low-flood seasons.

10 LOADING PROGRAM. Develop loading program curves for each hydro plant on system to show maximum kilowatt-hours that can be generated from available water and how to load different units to obtain this.

11 PLANT OUTPUT. Compare plant output with possible maximum. If these are not consistently close, find the cause and correct it.

12 PARALLEL OPERATION. When two or more plants operate in parallel on the same river, load each plant so all water through an upper one can be used in a lower without any of it going over the spillway.

13 RACKS. Keep racks clean to maintain a low head loss through them.

14 HEATED RACKS. Where necessary, install heated racks to keep them free of ice in frazil-ice periods.

15 RACKS' LOWER ENDS. Be sure racks are cleaned all the way to the bottom. Because they are clean at their top ends is no indication that they are not covered with debris at their lower ends.

16 FRAZIL ICE. During period of severe frazil ice, remove top half of racks if this can be done without danger to the waterwheels.

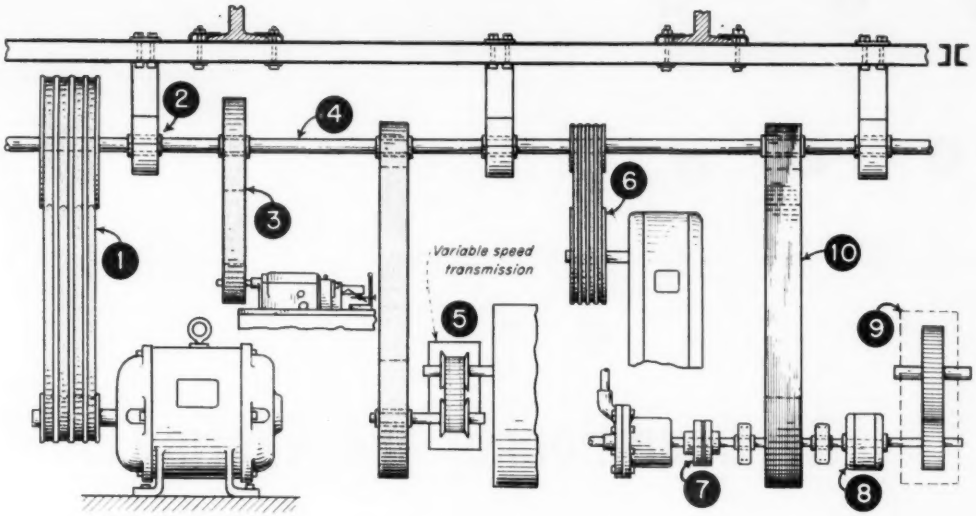
17 WORK SCHEDULE. Schedule maintenance work so that it can be done during normal working hours and not on costly overtime. Sometimes a simple change in plant layout will make this possible.

18 SWITCHING. The hookup (top right) shows how No. 17 may be done. By closing disconnects *A*, *B* and *C* and oil switch *O*, generator protection is transferred to this switch. Then generator switch *G* can be isolated and worked on. Switch *O* can serve any number of machines on the bus.

19 TURBINE RUNNERS. Watch for pitted areas on turbine runners and repair them by welding or metal spray during each overhaul period.

20 IMPULSE WHEELS. Keep impulse-wheel nozzles in good condition to maintain high efficiency.

21 SEAL RINGS. If seal rings on francis runners wear because of water conditions, replace them with stainless-steel ones, to keep water loss at a minimum and to reduce maintenance costs for frequent renewal.



Mechanical-Power Transmission

► COST CUTTING in an existing mechanical-power transmission system usually works out to be a matter of proper maintenance. Saving comes in reduced power bills when transmission losses are cut, and in lower operating cost when plant replacements are fewer.

1 MULTIPLE V-BELTS. General trouble sources are (1) too few belts (2) sheave diameters too small for belt cross section (3) sheaves with incorrect groove angles (4) belts run too fast (5) belts of wrong construction for a given application.

2 BEARINGS. Cut number of replacements by checking shafting lineup. Remember, dirt is a bearing's worst enemy, with improper lubrication running a close second. And poor lubrication can mean too much as well as too little. Consider sealed bearings where excess dust is present.

3 LEATHER BELTS. Standardize on as few belt widths and plies as economically meet plant requirements. This cuts down variety of spare belting that must be kept in stock. Belt should not creep or slip more than 2%. Frictional heat, created by too loose a belt, burns and cracks belt surface.

Where excessive tension is required to prevent slipping, substitute a wood or fiber pulley for the small steel one. Belt tension can be reduced by lagging small pulley with leather, rubber or duck.

4 SHAFTING. Excessive deflection is usual cause of shafting failures. Eliminate by carefully setting hangers. Mount hangers close to pulleys. Use channel iron for mounting hangers.

5 SPEED CONTROL. Consider mechanical infinitely variable-speed control mechanisms where wide speed changes are needed. Ac motors are generally restricted to a definite speed-control range. Dc motors with rectifiers and electronic speed control come into the infinite-speed range picture.

6 PULLEYS. Use pulleys up to sizes that give a belt speed of 5000 fpm. Up to this speed amount of power transmitted by belt increases about in direct proportion to pulley size.

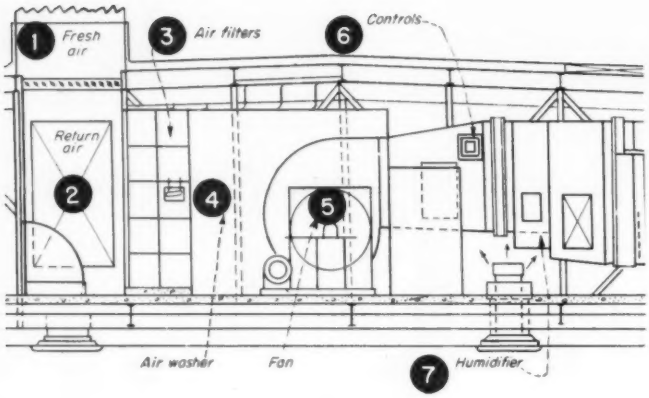
Excessive crown on a flat pulley may produce strains along belt center line and cause premature failure. Have pulley face ½ to 2 in. wider than belt. Save transmitting power by checking that pulleys are in line. Run a string alongside both pulleys with belt removed. String should touch at four points along rim of pulleys, if in line.

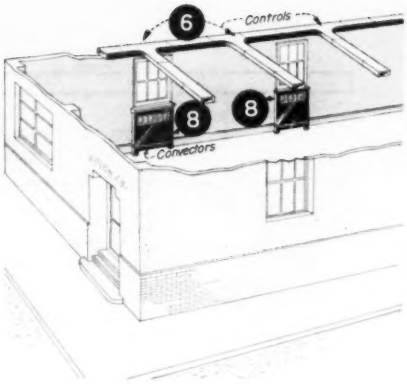
7 FLEXIBLE COUPLINGS. Coupled shafts transmit power at higher efficiency where shafts are perfectly in line. Flexible couplings are designed to compensate for unavoidable misalignment that creeps in after shafts are coupled. Bearing failures and shaft fatigue—because of alternate compression and tension on shaft's surface—result from excess misalignment.

8 CLUTCHES. Proper clutch allows use of smaller motor, operating at or near rated output. This reduces power consumption as well as improving plant electrical power factor.

9 GEARING. Cut down gear troubles and transmission losses by checking following points (1) center distance; too little root clearance if too short and backlash if too long (2) misalignment; it causes excessive shaft deflection, worn bearings and gears (3) lubrication (4) overloads and shock loads. Standard rules of careful inspection and good maintenance prevent gear problems cropping up.

10 CHAIN BELT. Consider shearing-pin sprockets where you run into trouble with machines stalling. An overload, sufficient to cause damage, will shear pins. Rim is then free to turn on the hub.





Air Conditioning and Heating

► How do you go about cutting costs in air-conditioning or heating systems? The steps you take must be tempered by a clear idea of what you want the system to do. You might, for example, reduce temperatures in all heated spaces during the winter months. That would certainly save money, but at a price. The price might be decreased production, product spoilage or disgruntled workers. So cost cutting must include the costs of the departments using the air conditioning or heating, as well as those of the department supplying it. The proper way to save dollars for everybody is to improve performance of all system elements to produce results at minimum outlay.

AIR CONDITIONING

Air conditioning is a 5-point job involving maintenance of (1) temperature (2) humidity (3) cleanliness (4) ventilation, and (5) circulation. All must be held to levels best suited to comfort and health (or to the needs of a process), without waste of power, steam or labor.

Let's check major parts of a typical air-conditioning system to see how these needs can be met. The drawing, above, left, illustrates bare essentials for a central air-conditioning system. To keep it simple, circuits for chilled water, refrigerant and heating coils don't show. Essentials are labeled and paragraphs below give pointers for improving operations and saving dollars.

1 AIR SUPPLY. You need a running comparison between wet-bulb and dry-bulb temperature to know economical proportions of fresh to return air. The right amount of each means less work for your conditioning equipment and lower operating costs. A recording wet-and-dry-bulb differential controller keys your system to outside air conditions.

An outdoor master thermostat that resets zone thermostats as temperature changes can save you heating dollars in spring months and air-conditioning dollars in fall months. By adding a hand control that can take over zone thermostat settings you prevent sharp jumps in load brought on by sudden outside temperature changes. These (1) overload equipment (2) push up maintenance costs (3) increase demand charges for purchased electricity or steam.

Never admit outside air directly to a conditioned room. It adds to the sensible heat load, runs up costs. Heating coils in path of incoming air prevent freezing in air washers, save maintenance dollars.

Make sure heating coils have good traps and are working properly. Condensate backing up in the coils keeps you from getting full money's worth in performance. Don't throttle steam supply to the coil unless it's designed for it. You can freeze up the coil and you'd face repair or replacement bills.

2 RETURN AIR. Such absorbers as activated carbon can remove smoke and some odors from return air. Then you can save dollars by using more return air, less fresh air.

3 AIR FILTERS. Make sure you're using the right kind for the job conditions. Dry filters serve well for low volumes, light dust. Viscous filters can tackle heavier loads and coarse dust. Where operating hours are long and large volumes must be handled, consider automatic filters. Balance first cost, higher for cleanable types than "throwaways," against maintenance and operating costs.

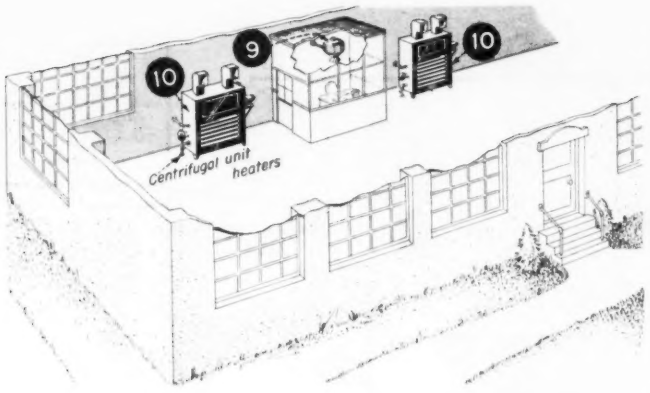
Be sure you have more filtering capacity than fan capacity. You can then get good air distribution through the filters without overloading them. This insures clean air under all conditions with little extra cost.

Check air speeds through filters. They give you the most for your money within a definite range of flow rates. These rates depend on filter type. Enlarging duct areas at filter spaces can improve filter efficiency by reducing flow rates. High filter efficiency gives cleaner air at lower cost.

Put in a differential draft gage between filter inlet and outlet chambers. It tells you when filters need cleaning, avoids overloading fans. Find out the range of pressure drops for your filter type. When higher pressure shows, clean them. For the throwaway types, this means replacement. Follow maker's directions for cleaning viscous filters, and recharging them.

Stationary electrostatic-cell filters also need cleaning. You can speed the job, and reduce out-of-service time, by putting in low-cost backup filters. Then you can use the fans to dry the plates after washing. Backup filters prevent any dust being blown into ventilated spaces.

For top performance at lowest cost keep oil level in sump of traveling-plate



electrostatic filters at recommended height. Remove sludge from sump.

Clean filters, working at best efficiency, prevent dark spots on ceilings of ventilated spaces, thereby saving painting and housekeeping costs.

4 AIR WASHERS. Air washers remove moisture by overcooling the air, after which it is reheated. Cooling coils do the dehumidification job in much the same way. Because of the direct mixing in washers, water usually does not need to be as cold for a given outlet air temperature.

Make sure washer eliminator plates are sound. If they let entrained moisture get through in the air stream, the humidity-correcting job is upset.

Chemical treatment of washer spray water can lengthen the life of the spray chamber and cut maintenance costs. This may take two forms: (1) adding an inhibitor to control corrosion, and (2) use of chemicals to kill bacterial growths. These latter get their start from bacteria washed out of the air. Under favorable conditions for bacterial development, these growths can seriously reduce washer capacity, cause high cleaning bills. A chemical feeder, to operate when the spray pump does, can often pay for itself. That way you're sure of correct treatment when it's needed.

Make sure the water circuit has a float valve to make up evaporation losses. That keeps washer performance up to peak. A quick-fill connection can help reduce maintenance and out-of-service costs. With it you can drain and refill washer circuit quickly.

Check the louvers on washer's inlet side. Their job is to distribute air flow evenly through the washer. The better they do it, the better the job done by the washer. If you don't have a waterproof access door, add one. With it you can check spray-nozzle action and keep the washer working at top level.

If you use cooling coils to lower air temperature below dewpoint, make sure fins are separated enough to let collected moisture drain off. If it doesn't, air bypasses the coil and up go air-conditioning costs. While you're at it, check condition of drip pans and drains to see that water keeps moving out of the chamber.

5 FANS, DUCTWORK. See that fan speed is set to handle total design air quantity. Fan should operate at best efficiency on normal loads.

Measure and record air quantities at each supply and return outlet. Then balance all outlets by dampers or blocking until they are within 10% of design conditions. This makes sure you're getting proper air distribution without overload on any part of system.

6 CONTROLS. You depend on controls to insure comfortable conditions and to operate equipment economically. Make sure they work as they should. If you don't already have them, put in permanent duct thermometers. They give you a running check on system performance.

7 HUMIDIFIERS. If you use direct humidifiers, remember they work only as well as their spray outlets. Keep outlets clean and spray fine. That's the way to low-cost humidification. Where drain pans collect and recirculate unevaporated water, be sure the circuit stays clean and unclogged, water keeps moving.

HEATING SYSTEMS

Biggest potential saving in any heating system is adequate control. Where there is no control, or only the crudest sort, people do their own controlling, usually by opening windows with heat full on. Result is waste and lack of real comfort. How much control will depend on building layout, type of occupancy, etc. Important point to remember is that lack of control is commonest cause of high heating costs.

Following are a few tips on other parts of the heating system. Numbers refer to sketches.

8 CONVECTORS, RADIATORS. Keep floor areas around convectors free of obstructions so air passes over all heating surface, doesn't bypass part of it. Check damper swing on convectors. This permits local temperature correction at little cost and without disturbing system balance.

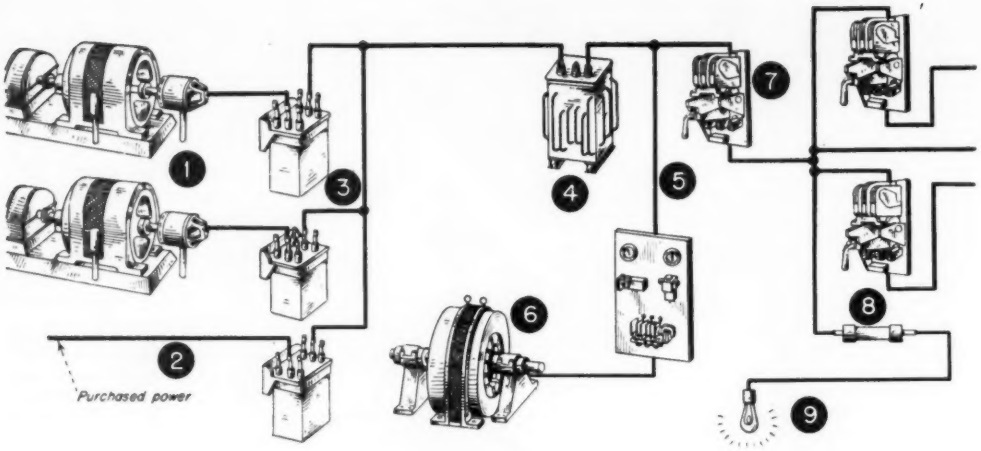
Remember always that best results and lowest costs go hand in hand when heat supply comes closest to matching heat needs. This means close attention to zoning so heat distribution can be changed to match changes in sun and wind loads, occupancy, etc. It also means use of orifices or similar devices to bring local heat requirements into line with needs. And, of course, don't overlook such simple steps as shutting off heat to parts of buildings temporarily unoccupied.

Be sure radiators and convectors are properly trapped. Keeping condensate moving insures getting full use of your heating investment.

9 SUSPENDED UNIT HEATERS. See that air-flow patterns overlap. That way you get even heat, avoid cold spots. Set heaters far enough away from wall areas so air-flow velocity dissipates. Then low-velocity air mixes intimately with infiltration air, heating area near exposed surface effectively. Skillful location of heaters permits getting comfortable conditions at lowest cost.

Where you have much traffic between inside and outside, it may pay to place unit heaters over the door opening. Rig them to turn on automatically as doors open and turn off when they close. This usually proves a low-cost way of combating infiltration.

10 CENTRIFUGAL UNIT HEATERS. Make sure area around floor-mounted heaters is free of obstructions near air intakes. You can't expect a unit to handle rated capacity unless incoming air travels over the full heating surface. Likewise, be sure nothing interferes with the "throw" of the heater. That throw should overlap with other units to give the uniform heat you pay for. If obstructions can't be avoided, consider wall or ceiling-mounted units. Remember, in the long run the lowest-cost heating system is the one that does a uniform job—uneven temperatures, drafts, stratification are wasteful.



Electricity and Elevators

► THERE ARE two basic ways to cut costs in your electrical system. First, select equipment wisely, and then take good care of it after installation. Since question of proper maintenance and operation plays an important part in cutting costs, many of the following items are in reality tips on good maintenance and operating practice.

Some of the following show up in dollars and cents as reduced cost for generating or purchasing power. Others pay off in the long run by decreased *down time*, less replacement of parts and lengthening of equipment life.

1 GENERATORS. Schedule operation so each running unit is pulling at or close to its rated load. This is the region of maximum generator efficiency.

Regulate load, as explained later, so generators operate as close to unity power factor as is economically advisable.

2 PURCHASED POWER. When tied in with public utility, swing load peaks to your own generators. This keeps your demand charge down. New, fully automatic load regulators can confine all load swings to local generators.

Study your rate schedule carefully; it may show how additional savings can be made. Avoid adding new blocks of load near end of month. If possible stall it off till start of succeeding month.

High peak loads may occur only a few times a month. Check if some other load can be disconnected for this period to avoid upping the demand. Is it possible to handle some process operations at night to reduce daytime peaks? For example, where heat treating and baking are handled electrically, it may be wise to operate them at night during the off-peak period. Then again, what about staggered starting of peak loads?

Consider spotting a few time clocks in circuits that can be cut out during peak periods. Electric water heaters are a good example.

3 OIL CIRCUIT BREAKERS. Has increased generating capacity outrated interrupting capacity of switchgear? Then it may be wise to consider air core reactors if new switch-gear is not an immediate possibility.

4 TRANSFORMERS. Test oil annually for dielectric strength using standard test rig. Filter oil if it breaks down at less than 17.5 kv. Check operating temperature at least once a month; oil temperature should never exceed 90 C with transformer fully loaded.

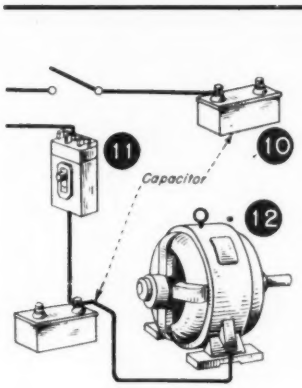
5 WIRING. Consider constant power loss where feeders and circuit wiring are overloaded. Load can be reduced by improving power factor. Remember that even the best grades of rubber insulation deteriorate in time, and that end is hastened when operating temperature is above allowable maximum.

6 SYNCHRONOUS MOTOR. This unit is often used in conjunction with induction motors to raise total plant pf. In many cases it costs less and has a higher efficiency than the corresponding induction motor; this is especially true of slow-speed jobs.

7 AIR CIRCUIT BREAKERS. Examine main contacts periodically for signs of overheating (copper turns a bluish color). Use tissue paper and prussian-blue dye to check area of contact surface. Scrape arc-chutes clean of copper beads to avoid leakage to ground and possible flashover—especially on a dc system.

8 FUSES. They are often literally the weak link in plant wiring system. Once again, check for signs of overheating—often caused by poor contact at fuse ends. Where fuses are paralleled measure current through each fuse with a split-core ammeter. Unbalance can usually be traced to increased resistance at the clips of one fuse. Correct; otherwise you'll invite blown fuses.

9 LIGHTING. Get maximum light output by cleaning fixtures periodically. At same time remove any lamps (incandescent and fluorescent) that have exceeded their life expectancy. Scrap-



ping them then will increase light output and save a trouble call later. Invest in a light meter to assure good lighting in critical working areas.

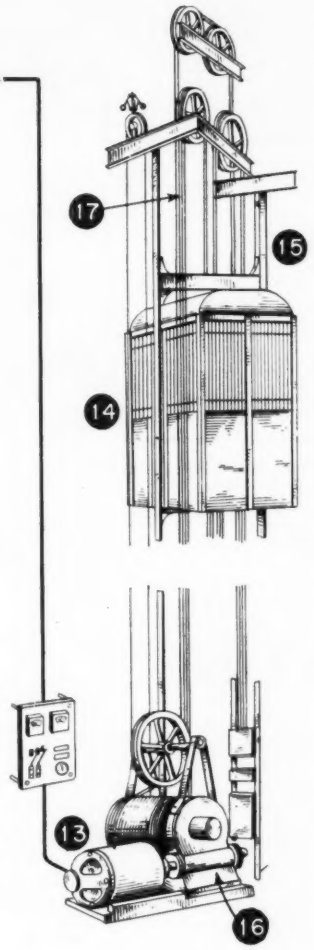
10 SHUNT CAPACITORS. Good method for improving pf and maintaining high load voltage. Best bet is to locate banks at convenient spots around plant to be switched with varying load requirements. Supplement with capacitors tied in directly with motors. Rough cost for installed capacitor is $10 per kvar.

11 MOTOR STARTER. Check overload devices by sending low-voltage tripping current through with motor disconnected. Use step-down transformer having high-current secondary rating. Measure test current with split-core ammeter.

12 INDUCTION MOTOR. Don't stop at the basic maintenance rules regarding cleanliness and lubrication. Keep track of insulation resistance. You can often spot trouble beforehand by noting any downward trend in your insulation-resistance curve. Take one megohm as the minimum insulation resistance per 1000 v.

13 ELEVATOR MOTOR. Changing from old low-starting torque squirrel cage to high-starting torque motor of modern design often saves up to 50% on elevator power bill.

14 MILEAGE RECORDERS. Install car mileage recorders and stop counters. These records show you how elevator service and operation can be improved.



15 GUIDE RAILS. Keep rails well lubricated. Guide shoes that should be lubricated and are running on dry rails take extra power.

16 GEARS. Lubricate gear case. But don't flood it with oil because worm and gear will then act as a pump and agitator to increase power consumption.

If gears don't have a highly polished mating surface, put about one lb of sulphur in gear-case oil. Operate for a day, then clean out and refill with fresh oil.

17 ELEVATOR ROPES. You can cut costs by increasing rope life through regular lubrication and careful inspection. Check that sheaves are running in good bearings. Keep load equalized on ropes. Check rope sockets about every six months.

18 BRAKES. Keep brakes adjusted properly so car stops level with floor. This holds for both automatic and hand-operated elevators. Don't let shoes ride the brake wheel; it wears the shoes, heats the brake, and increases power consumption.

On hand-operated elevators, train operators to make accurate stops. Inching a car to floors uses extra power and shortens rope life.

19 RELAYS. Check operation annually by external test current. Don't overlook current transformer on feeder or machine when making relay check. Simple series lamp test shows if ct secondary winding is continuous; comparative brightness to other cts shows up partly shorted secondaries.

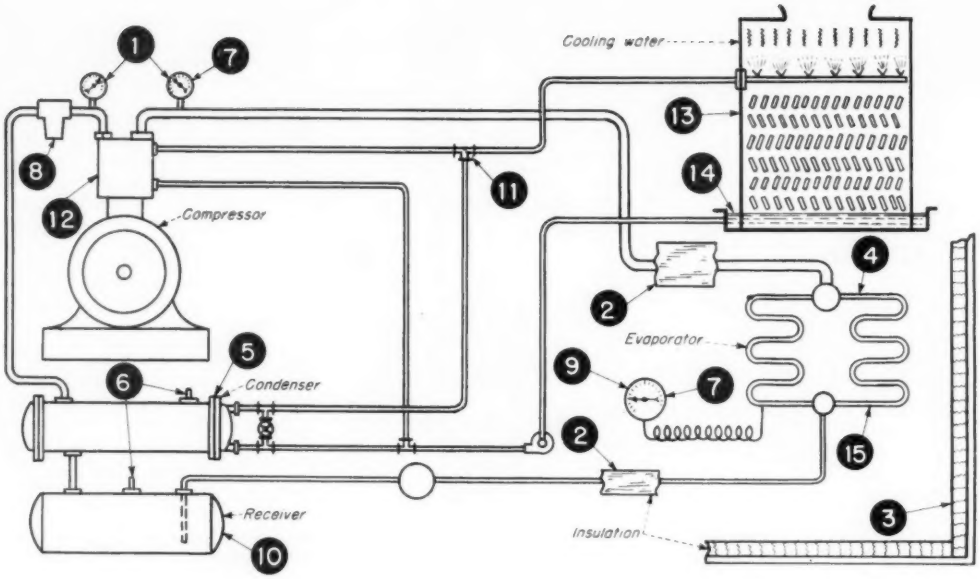
20 BRUSHES. Check brushes daily on motors in severe service; once a week is okay for others. Save commutator and slipring repair bill by replacing all short brushes. If they are left in place till they wear to the pigtail, metal ring in brush itself will cut into commutator or slipring.

Blow out brush boxes with compressed air; then see that brushes slide freely in their holders. Keep brush pressure at recommended level to reduce sparking and commutator wear.

21 CONTACTS. One of the most frequent reasons for trouble calls on automatic electrical equipment is faulty contacts. Don't file silver contacts unless badly burred. Wipe them clean with carbon tetrachloride. Adjust contact pressure for adequate wipe when contacts make up; this insures low contact resistance between surfaces.

22 LIGHTNING ARRESTERS. Inspect in early spring before start of lightning season. Check condition and resistance of ground connections. Resistance should not be over 5 ohms. If wire from lightning arrester to ground runs through conduit, make sure wire and conduit are bonded together.

23 LOAD CHECK. Put portable ammeter and voltmeter to good use by periodically checking current and voltage taken by plant motors. Split-core ammeter and voltmeter combination is well suited for this job. This will show up overmotoring and overloading. Both can cause trouble. Former lowers plant pf and motor operating efficiency. Overloading and resulting high operating temperatures cuts machine life.



Refrigeration

► FOR LOW-COST REFRIGERATION, cut out every loss that makes the plant uneconomical. But stay within reason. There is usually a point beyond which the Btu saved will not give a reasonable return on the investment.

Important point is to study the plant to determine how far the improvements should go. As a starter, set up a check list as follows:

1 SYSTEM PRESSURES. As suction pressure goes down, machine capacity goes down with it. A drop of 15 psi on a certain size of ammonia compressor can reduce its capacity 40%. A 10-psi increase in head pressure can mean an increase of 0.10 brake horsepower per ton. Reduction of head pressure must be balanced against cooling-water cost.

2 PIPE INSULATION. Liquid and suction lines should be insulated between compressor and evaporator if appreciable heat can be picked up from surrounding areas.

3 WALL INSULATION. Watch building construction and see that insulation thickness is uniform throughout. Repair sagging material and waterproof it to keep moisture out.

4 FROST COATING. Frost on evaporator surfaces may feel cold to the touch but it is still a good insulator against heat flow. Defrost regularly.

5 CONDENSER. Keep internal surfaces free of silt, scale and oil. Running a tapered reamer, same size as tube's internal diameter, will remove scale coating.

6 PURGERS. Accumulation of air and noncondensable gas raises the head pressure. To get more tonnage at lower cost install a good automatic purger where gases collect.

7 GAGES, THERMOMETERS. Use instruments to find out what goes on inside the system. Connect them permanently and test periodically to keep them accurate.

8 OIL SEPARATOR. Oil carryover from the compressor should be trapped and removed before it reaches the condenser where it congeals on the surfaces. Watch receiver for oil.

9 RECORDS. Read all instruments hourly and keep accurate records of performance. Any change from normal readings indicates system trouble.

10 RECEIVER. Install receiver in as cool a spot as possible, or insulate. Heat pickup above condensing temperature means less refrigerating effect in evaporator.

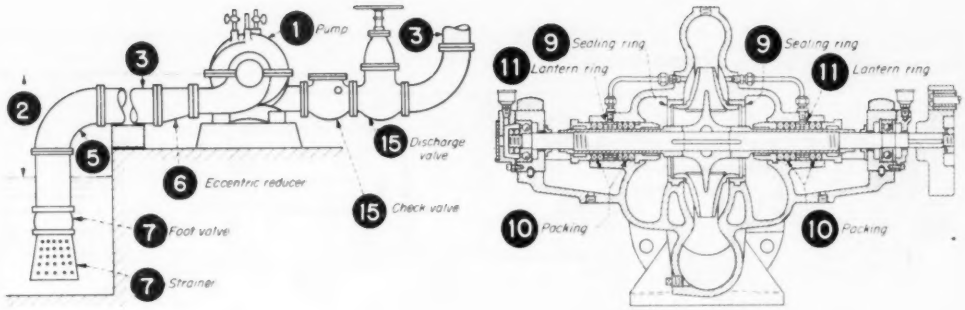
11 PIPE JOINTS. Leaks cost money in lost refrigerant. Use care in making joints; see that they are tight. A refrigeration system can be operated without having the odor of refrigerant permeate the entire plant.

12 COMPRESSOR. Inspect valves, false head (if used) and piston rings, and keep them tight. Leakage means lowered capacity, and sometimes more horsepower per ton.

13 COOLING TOWER. Inspect tower for broken or misplaced filling, plugged nozzles and algae that cause uneven water distribution. Keep clean. Check evaporative condensers for dirt and leaking tubes.

14 COOLING WATER. Scale and algae plug water passages and coat the surfaces. Install a treating process to take care of impurities.

15 EVAPORATORS. Heat flow to refrigerant depends on temperature head and surface area. Keeping only half the evaporator surface covered with refrigerant liquid means a greater temperature drop from load to refrigerant for same amount of heat to be absorbed in a given time.



Water Services

► To do a real job of cutting costs in a water-supply system you must start before the pumps are selected. Mistakes in selecting and installing units can greatly increase power and maintenance costs. A pump not suited for a service probably can't be made to run satisfactorily.

1 THE RIGHT PUMPS. Select pumps of the right size and design for the job, built of suitable materials for the liquids to be handled.

2 SUCTION LIFT. Be sure suction lift is not too high for the pump used, or vapor pressure and temperature for liquid pumped. Have suction line tight. Air leaks reduce pump capacity and increase pumping costs.

3 PIPE SIZE. Have piping plenty large. Generally a pipe one or two sizes larger than pump's nozzles should be used. If in doubt use larger size.

4 PIPE LOSSES. Run pipe as direct and with as few elbows as possible, to keep down losses. Some industrial piping jobs have required more power to pump the water through them than to overcome the static lift.

5 PIPE ELBOWS. Where necessary to use suction elbows, use long-radius ones and install them so as not to disturb flow into pump.

6 PIPE REDUCERS. Where a pipe reducer must be used at pump, use an eccentric one to eliminate air pockets.

7 FOOT VALVES. When suction strainers or foot valves are used make sure they are free of obstructions.

8 USE METERS. On large pumps install suitable gages and flowmeters to show pump performance at all times.

9 WEARING RINGS. When you suspect pump performance is off, check wearing-ring clearance on centrifugal pumps and piston packing on reciprocating pumps. Leakage here may equal much of the pumping effort.

10 PACKING. Keep pumps properly packed and don't use excessive pressure on the packing gland. Some leakage through packing is necessary to cool and lubricate it. Tight packing on small power-driven pumps may overload the driving motor.

11 LANTERN RINGS. When necessary, use a lantern ring on centrifugal pumps in stuffing box for sealing, cooling and lubricating the packing.

12 WATERCOOLED BOX. When pumping hot or highly volatile liquids use a watercooled stuffing box.

13 RECIPROCATING PUMPS. On direct-acting pumps, keep the steam end in good condition and the valves properly set.

14 PISTON PACKING. On the water end keep piston packing and valves in good condition so fluid won't bypass from discharge to suction. Power consumption on these pumps is about as high when 25% of their capacity is being bypassed as when all goes out the discharge line.

15 DISCHARGE LINE. Make sure the discharge line is not obstructed, say, by partly closed valves. On reciprocating pumps, pressure and power go up in proportion to discharge pressure.

16 WELL PUMPS. With deepwell turbine pumps don't overpump well, because it increases the pumping head and may allow air to enter the pump. Both increase power consumption.

17 EFFICIENT USE. After a water supply has been made available at minimum cost, be sure it is used efficiently.

18 SAVE WATER. Don't let water run to waste when not needed.

19 VALVES STICK OPEN. See that all lavatory valves seat tight and that none sticks open. Cases are on record where water ran to waste as fast through these valves as it was pumped into the storage tank.

20 COOLING WATER. Where water is used for cooling, regulate flow to the minimum that will do the most efficient job. More than this may reduce efficiency of the equipment cooled and cause a double loss.

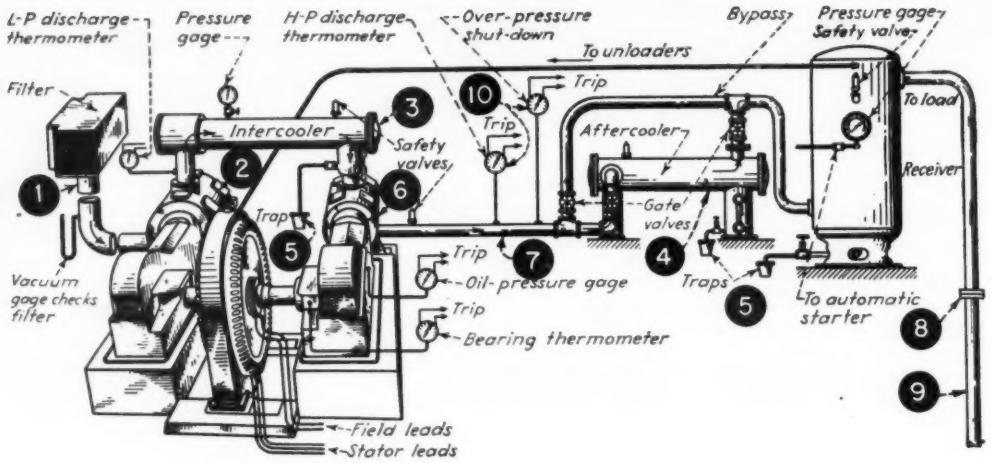
21 UNSEEN LEAKS. Where water line runs underground, or in out-of-the-way places, be sure there are no undiscovered leaks.

22 WATER CONNECTIONS. Check all water piping. A forgotten connection may be open to the sewer. Such things do happen and cause large water losses.

23 DISTRIBUTION METERS. Meter water to each major department in industrial plants and charge each for the water used.

24 HOT WATER. Don't overheat or underheat water for hot-water systems. Both extremes are wasteful.

25 CIRCULATE WATER. Circulate hot water to maintain normal temperature near services. Otherwise, much water is wasted before it runs hot from taps in wash rooms and elsewhere.



Compressed-Air Systems

► AIR IS FREE until it enters a compressor intake. From then on it costs money and every saving made in its compression and use helps whittle down operating expenses. As a start on cutting waste, survey and inspect the entire system from filter to furthermost outlet valve, including air-operated tools. A leaking valve on a rock drill or pavement breaker can waste a lot of air.

1 INTAKE. Don't starve the compressor. General rule is to increase intake pipe diameter 1 in. for every 10 ft of length to cut down flow resistance. Put a good filter on the entrance to catch dirt and foreign matter. Use enough filter area to give full air flow without too much pressure drop. High pressure drop in intake line means less weight of air taken in on suction stroke and more horsepower to produce a given weight of air.

Put intake entrance at coolest spot possible and cover with a rain hood. If intake line runs through hot area put on insulating covering. To produce 1000 cu ft of free air at 70 F (rating temperature) a compressor needs 1038 cu ft of 90-F air or 1076 cu ft of 110-F air. For every 5-F reduction in intake-air temperature there is an actual capacity gain of 1%. Also, if every 1000 cu ft of air taken in contains 30 cu ft of vapor or steam from nearby exhausts, condensation in intercooler and aftercooler will cut air output down accordingly. Horsepower is wasted in compressing moisture.

2 COMPRESSOR VALVES. If unit is old, and fitted with heavy slow-moving valves, modernize it by installing new valves or a completely new cylinder. Sluggish valves upset cylinder pressures and reduce output.

3 INTERCOOLERS. Compression ratio in each cylinder determines intercooler pressure. Any change in this pressure indicates trouble (leaking valves, etc) in one of the interconnected cylinders, or perhaps loss of cooling water. Keep pressure at normal so load distributes properly between cylinders.

4 AFTERCOOLER. This is the last chance to cool the air so excess moisture precipitates before it enters distribution lines to freeze or wash lubricant out of tools. If air goes directly to pneumatic hammers etc, utilize the heat of compression by bypassing the aftercooler.

5 TRAPS. Put moisture traps on intercooler, aftercooler and receiver to drain off water before it gets into distribution lines. Where lines go through cold areas install additional moisture separators and traps.

6 COMPRESSOR LOADING. Minimize unloading or part-load operation of constant-speed units. Mechanical efficiency is best at full-load because friction losses remain practically constant. Machine capacity should fit the load. Intermittent operation at full load is more economical in power consumption than continuous running at part load.

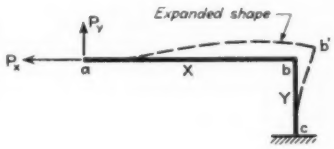
7 VIBRATION. Pulsation and shaking forces cause joint leaks and wreck pipelines. Discharge lines between compressor and receiver should be short and without sharp elbows. Use long-radius bends and large receivers. If vibration still appears insert snubber chamber in discharge line.

8 LEAKS. Keep air-line joints and valves tight. At 100 psi a 1/16-in. hole loses 6 cu ft of air a minute. At a production cost of 6¢ per 1000 cu-ft a leak this size costs 2¢ an hour. Multiply by five or six, and the total loss is greater than lubricating-oil cost.

9 PRESSURE DROP. There is not much profit in spending good money compressing air and then losing one third of the pressure through friction loss in a skimpy distribution line. Low air pressure at tools means less output per man-hour. Recommendations for pressure drop are 1% per 100 ft of line, or 5 psi over entire line. Connect two headers into ring system if possible, or use pipe size most economical from standpoint of over-all production and use.

10 ALARMS. High pressure can rupture pipes and receivers and high temperature, in the presence of oil, can cause fire and explosion in the system. Eliminate these hazards and prevent costly wrecks by installing pressure and temperature alarms.

NOTATION AND EQUATIONS



X = longer leg, ft
Y = shorter leg, ft
Δ_x = expansion of longer leg, in.
Δ_c = corrected expansion of longer leg, in.
E = modulus of elasticity of pipe, psi
I = moment of inertia of pipe, $in.^4$
OD = outside diameter of pipe, in.
S_a, S_b, S_c = stress in pipe at points a, b, c, respectively, psi
P_x, P_y = thrusts between anchors, lb
K_a, K_b, K_c = stress correction factors
C_x, C_y = thrust correction factors

No. 1

$$S_a = \left[\frac{(\Delta_x)\,E\,(OD)}{48\,Y^2}\right]\cdot K_a$$

$$S_b = \left[\frac{(\Delta_x)\,E\,(OD)}{48\,Y^2}\right]\cdot K_b$$

$$S_c = \left[\frac{(\Delta_x)\,E\,(OD)}{48\,Y^2}\right]\cdot K_c$$

No. 2

$$P_x = \left[\frac{(\Delta_x)\,E\,I}{144\,Y^3}\right]\cdot C_x$$

$$P_y = \left[\frac{(\Delta_x)\,E\,I}{144\,Y^3}\right]\cdot C_y$$

No. 3 (For stress governing)

$$\Delta_c = (\Delta_x)\left(\frac{E}{26{,}000{,}000}\right)\left(\frac{10{,}000}{S}\right)\cdot K_c$$

No. 4 (For thrust governing)

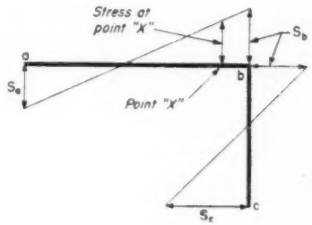
$$\Delta_c = (\Delta_x)\left(\frac{E}{26{,}000{,}000}\right)\left(\frac{1{,}000}{P}\right)\cdot C_x$$

Quick Check for Pipe Stress, Thrust

Tables and curves developed by J J Blank, piping designer, make the job easy. Here he gives step-by-step instructions for use of the method. Typical examples show how it is applied in practice

► PIPING DESIGNERS often need to find out quickly whether a given system is adequate for allowable stress and thrust. To make this job easy you will find tables and curves on the next two pages. With them are outlines of the steps to follow in applying this method, and typical illustrative examples.

Basis for Tables. While the tables, curves and instructions are complete and can be applied without explanation, many engineers will want to know how they were derived and what their limitations are. The tables are constructed on the basis of the "guided cantilever"—a beam with one end fixed and the other free to deflect but locked against rotation. Knowing expansion of longer leg (Δ_x), we find in the tables a direct answer in terms of



minimum length of leg *Y*. Values of 10,000 psi for allowable stress, 1000 lb for allowable thrust, and 26,000,000 psi for modulus of elasticity, were chosen to make sure the answer would be on the safe side. Notations used and all the applicable equations are given in the box above, along with a diagram of the typical case. Equations 3 and 4 prove necessary only in critical cases.

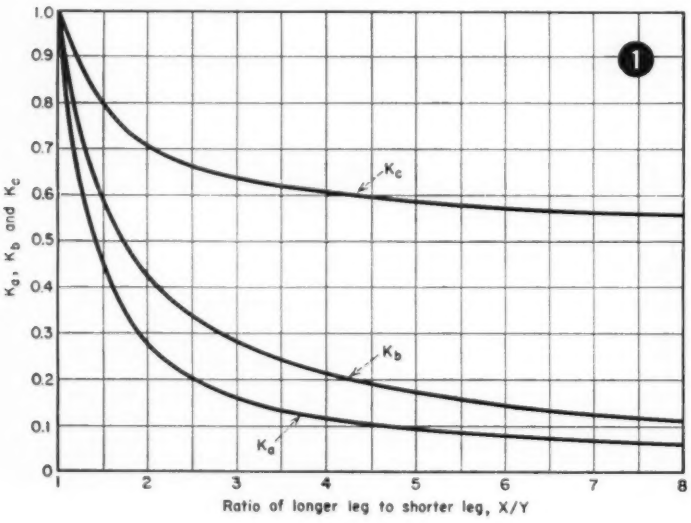
Correction Curves. Use of curves 1 and 2 (next page), along with the tables, yields an accurate figure for minimum length of leg *Y*. These curves correct the guided cantilever equations. They were computed by use of the familiar S W Spielvogel calculation method, which is considered accurate.

Thrust in direction of longer leg (P_x) is always maximum. But allowable shear thrust on nozzles sometimes governs (1000 lb usually being maximum allowable) and thus thrust in shorter leg (P_y) may be desired. Stress at fixed end of shorter leg (S_c) is always maximum. Allowable stress for

TABLE I—MINIMUM LENGTH OF GUIDED CANTILEVER, STRESS GOVERNING

Figures in body of table are required minimum length of guided cantilever beam to create stress of 10,000 psi with modulus of elasticity of 26,000,000 psi

Nom Dia	Δ_c = EXPANSION OF LONGER LEG (CORRECTED) IN INCHES																
	0.1	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	4.0	5.0	7.0	10.0
1	2.67	3.77	5.33	6.54	7.55	8.44	9.25	9.99	10.7	11.3	11.9	13.3	14.6	16.9	19.8	22.5	26.7
1½	3.21	4.54	6.41	7.85	9.06	10.2	11.1	12.0	12.8	13.6	14.3	16.0	17.6	20.3	22.7	26.9	32.1
2	3.59	5.07	7.16	8.78	10.1	11.3	12.4	13.4	14.3	15.2	16.0	17.9	19.7	22.7	25.3	30.1	35.9
2½	3.94	5.58	7.88	9.66	11.1	12.5	13.7	14.7	15.8	16.7	17.6	19.7	21.6	24.9	27.8	33.0	39.4
3	4.35	6.16	8.71	10.7	12.3	13.8	15.1	16.3	17.4	18.5	19.4	21.7	23.8	27.5	30.8	36.5	43.5
4	4.95	6.98	9.86	12.1	13.9	15.6	17.1	18.4	19.8	21.0	22.0	24.6	27.0	31.2	34.8	41.3	49.3
5	5.50	7.77	11.0	13.4	15.5	17.4	19.0	20.5	22.0	23.3	24.6	27.4	30.1	34.8	38.8	46.0	55.0
6	5.98	8.48	12.0	14.7	16.9	18.9	20.8	22.4	24.0	25.4	26.8	29.9	32.8	37.9	42.4	50.2	59.8
8	6.85	9.66	13.6	16.7	19.3	21.6	23.7	25.5	27.4	29.0	30.5	34.1	37.4	43.2	48.2	57.2	68.5
10	7.65	10.8	15.3	18.7	21.6	24.2	26.4	28.5	30.6	32.4	34.2	38.2	41.8	48.3	54.0	64.0	76.5
12	8.31	11.7	16.6	20.3	23.5	26.3	28.8	31.0	33.3	35.2	37.2	41.5	45.5	52.6	58.7	69.6	83.1
14	8.70	12.3	17.4	21.3	24.6	27.5	30.1	32.4	34.8	36.9	38.9	43.4	47.7	55.0	61.4	72.9	87.0
16	9.50	13.1	18.6	22.8	26.3	29.4	32.3	34.7	37.3	39.4	41.6	46.0	51.0	58.9	65.8	78.0	93.0
18	9.87	14.0	19.7	24.2	27.9	31.2	34.2	36.8	39.6	41.8	44.2	49.3	54.1	62.5	69.8	82.7	98.7
20	10.4	14.7	20.8	25.5	29.4	32.9	36.1	38.8	41.7	44.1	46.5	52.0	57.0	65.8	73.5	87.1	104
24	11.4	16.1	22.8	27.9	32.2	36.0	39.6	42.5	45.6	48.3	51.0	57.0	62.5	72.1	80.5	95.5	114
30	12.7	18.0	25.5	31.2	36.0	40.3	44.2	47.6	51.0	54.1	57.0	63.6	69.8	80.7	90.1	107	127
36	14.0	19.8	27.9	34.2	39.5	44.1	48.5	52.1	55.9	59.2	62.4	70.0	76.5	88.5	98.6	117	140



equipment nozzles may, however, be lower than for the pipe itself. Hence stress at other points may be desired.

To obtain stress at any point in the pipe structure, draw it to scale. Lay out the stress diagram to any scale (see preceding page). Stress at any point *X* may then be scaled from the diagram.

Effect of bends (curved pipe) can be omitted unless they are large in proportion to tangent (straight) lengths. Usually, bends or weld-elbows increase stresses and thrusts less than 15%. For this reason they are not considered here.

Applications. In the paragraphs that follow, tables and curves are applied to three typical problems. In each, the procedure to follow in the general case is outlined step by step. Then a typical example is worked out from given data showing how the procedure applies in a specific case.

A. FOR QUICK RESULTS, ALWAYS ON THE SAFE SIDE

1. Compute Δ_x

2. Enter Table I with Δ_x (in the horizontal line Δ_c) and pipe size. Obtain minimum length of leg *Y* for stress governing

3. Enter Table II with Δ_x (in horizontal line Δ_c) and pipe moment of inertia. Obtain minimum length of leg *Y* for thrust governing

EXAMPLE NO. 1

GIVEN DATA:

Schedule 40 (std wt) pipe, 3-in. dia
OD = 3.5 in.
I = 3.0 in.^{4}
Operating temperature = 200 F
Thermal expansion = 1.03 in./100 ft.
Allowable stress = 10,000 psi
Allowable thrust = 1000 lb
X = 20 ft
Y = 10 ft

QUESTION: Is this bend satisfactory for the given data?

1. $\Delta_x = 20 \text{ ft } (\frac{1.03 \text{ in.}}{100 \text{ ft}}) =$ 0.206 in.

2. Enter Table I with 0.206 in. (in horizontal line Δ_c) and with pipe size. By interpolation, this gives 6.16 ft as the minimum length of a guided cantilever that will produce a stress of 10,000 psi. Since the required length is 6.16 ft and the actual length of *Y* is 10 ft, the system is safe for stress

3. Enter Table II with 0.206 in. and the moment of inertia (*I*) of 3.0 in.^{4} The resulting value of 4.77 ft is the minimum length of leg *Y* to produce a thrust of 1000 lb. Since the actual length of *Y* is 10 ft, the actual thrust will be less than 1000 lb.

B. FOR ACCURATE MINIMUM LENGTH OF LEG *Y*

1. Compute Δ_c using equation 3

2. Enter Table I with Δ_c and pipe size. Obtain actual minimum length of leg *Y* for stress governing

3. Compute $\triangle_c$ using equation 4

4. Enter Table II with $\triangle_c$ and pipe moment of inertia. Obtain actual minimum length of leg *Y* for thrust governing.

EXAMPLE NO. 2

GIVEN DATA:

Schedule 80 pipe, 12-in. dia.
OD = 12.75 in.
I = 475 in.^{4}
Operating temperature = 700 F
E at 700 F = 25x10^6
Thermal expansion = 5.75 in./100 ft
Allowable stress = 12,000 psi
Allowable thrust = 2000 lb
X = 80 ft
Y = 50 ft

QUESTION: Is this bend safe for allowable stress, thrust?

1. $\triangle_x = 80\ (\frac{5.75}{100}) = 4.6$ in.

2. Enter Table I with 4.6 in. and obtain minimum length of *Y* as 56 ft. This is length of guided cantilever that will give a stress of 10,000 psi. Since actual length of *Y* is less than 56 ft. namely 50 ft. a guided cantilever of this length will exceed allowable stress. But the system does not act as severely as a guided cantilever and the correction below will show whether the system is safe as is.

3. Calculate $\triangle_c$ from equation 3. It works out to 2.86 in.

4. Enter Table I with 2.86 in. and read opposite 12-in. pipe the value of 44 ft (interpolated). This means that length of 44 ft for *Y* will be adequate. Since we have 50 ft. the system is safe for stress.

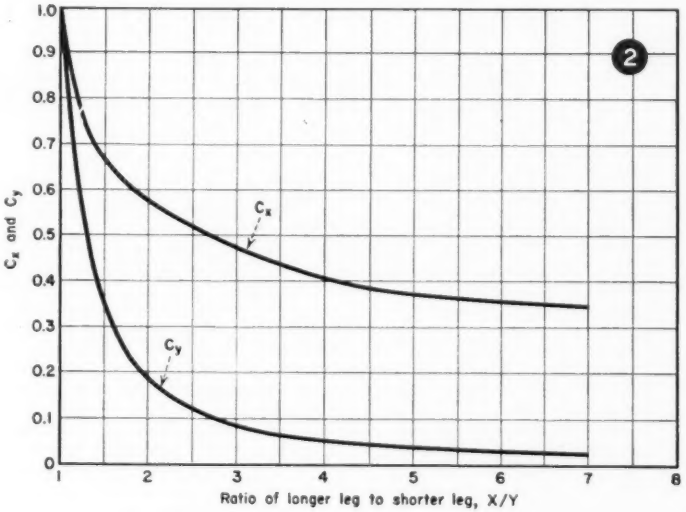
5. Compute $\triangle_c$ using equation 4. It works out to 1.47 in.

6. Enter Table II with 1.47 and value of *I* (475). Find actual minimum length of *Y* to be 49 ft. Since we have 50 ft the system is safe for thrust.

TABLE II—MINIMUM LENGTH OF GUIDED CANTILEVER, THRUST GOVERNING

Figures in body of table are required minimum length of guided cantilever beam for an allowable thrust of 1000 lb, with modulus of elasticity of 26,000,000 psi

I	$\triangle_c$ = EXPANSION OF LONGER LEG (CORRECTED) IN INCHES														
	.05	.10	.15	.2	.3	.4	.6	.8	1	1.5	2	4	6	8	10
.05	.77	.97	1.11	1.22	1.39	1.53	1.75	1.93	2.08	2.38	2.63	3.31	3.77	4.16	4.48
.10	.97	1.22	1.39	1.53	1.75	1.93	2.21	2.43	2.63	3.00	3.31	4.16	4.77	5.25	5.64
.20	1.22	1.53	1.75	1.93	2.21	2.43	2.78	3.06	3.31	3.78	4.16	5.25	6.00	6.60	7.11
.40	1.53	1.93	2.21	2.43	2.78	3.06	3.50	3.86	4.16	4.77	5.25	6.60	7.55	8.31	8.95
.80	1.93	2.43	2.78	3.06	3.50	3.86	4.42	4.87	5.25	6.00	6.60	8.31	9.52	10.4	11.3
1.50	2.58	3.00	3.44	3.78	4.35	4.77	5.45	6.00	6.47	7.41	8.31	10.3	11.7	12.9	13.9
3	3.00	3.78	4.35	4.77	5.45	6.00	6.87	7.55	8.14	9.33	10.5	12.9	14.8	16.3	17.6
5	3.56	4.48	5.15	5.64	6.46	7.11	8.15	8.95	9.66	11.1	12.2	15.3	17.6	19.3	20.8
10	4.48	5.64	6.46	7.11	8.15	8.95	10.3	11.3	12.2	13.9	15.3	19.3	22.1	24.3	26.2
20	5.64	7.11	8.14	8.95	10.3	11.3	12.9	14.2	15.3	17.6	19.3	24.3	27.8	30.6	33.0
40	7.11	8.95	10.3	11.3	12.9	14.2	16.3	17.9	19.3	22.1	24.3	30.6	35.0	38.6	41.6
80	8.95	11.3	12.9	14.2	16.3	17.9	20.5	22.5	24.3	27.8	30.6	38.6	44.1	48.7	52.4
100	9.70	12.2	13.9	15.3	17.5	19.3	22.1	24.3	26.2	30.0	33.0	41.6	47.5	52.5	56.5
150	11.1	13.9	15.9	17.5	20.1	22.1	25.3	27.8	30.0	34.4	37.8	47.5	54.4	60.0	64.5
300	13.9	17.5	20.1	22.1	25.3	27.8	31.9	35.0	37.8	43.3	47.5	60.0	68.6	75.6	81.4
500	16.5	20.8	23.8	26.2	29.9	33.0	37.8	41.6	44.8	51.4	56.5	71.1	81.4	89.6	96.4
700	18.5	23.3	26.6	29.3	33.5	37.0	42.6	46.5	50.2	57.5	63.2	79.5	91.0	100	108
1,000	20.8	26.2	30.0	33.0	37.7	41.6	47.6	52.4	56.5	64.7	71.1	89.6	103	113	121
2,000	26.2	33.0	37.8	41.6	47.6	52.4	60.0	66.9	71.1	81.5	89.6	113	129	142	153
4,000	33.0	41.6	47.6	52.4	60.0	66.0	75.4	83.2	89.6	103	113	142	162	179	193
8,000	41.6	52.4	60.0	66.0	75.4	83.2	95.2	104	113	129	142	179	204	226	242



C. TO OBTAIN ACTUAL VALUES OF STRESS AND THRUST

1. Use equation 1 for stresses at points *a*, *b* and *c*

2. Make use of equation 2 for the thrusts P_x and P_y

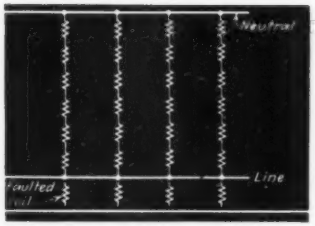
EXAMPLE NO. 3

GIVEN DATA:

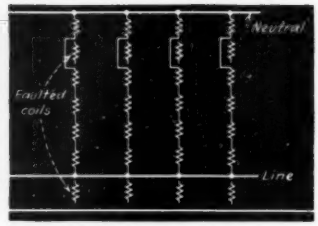
Same as for example No. 2

QUESTION: What are the actual stresses and thrusts?

Substituting in equation 1, obtain:
S_a = 4880 psi S_c = 9450 psi
S_b = 6590 psi
Substituting in equation 2, obtain:
P_x = 1990 lb P_y = 880 lb



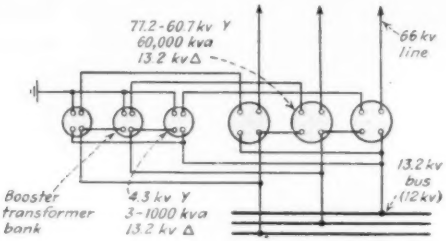
1 Winding is balanced after fault by cutting out coil in each series group



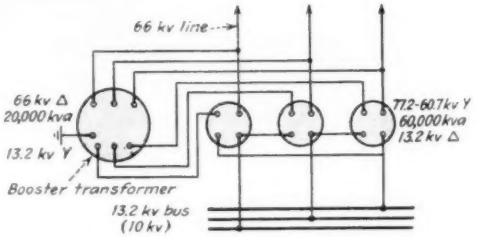
2 Machine is left with 72% of original winding after second change is made

Stator coil fails just as capacity is badly needed. Faulty coil is cut out, winding balanced, booster transformer added, and machine's back on job

BY D W DEWEY
Asst Superintendent of Substations
The Cincinnati Gas and Electric Co



3 Booster transformers used to aid regular transformer-bank lift 12 kv from repaired generator to voltage of high line



4 After second repair a spare 20,000-kva transformer is used along with main bank to raise generator voltage from 10 kv

Large Generator Operates in Pinch With Only 72% of Stator Coils

► EVERY AVAILABLE KILOWATT of capacity was sorely needed when trouble developed in one of our 23-year-old generators. Fault occurred in the stator winding of a machine rated 47,360 kva at 13.2 kv. Rough estimate showed between five and six months would be needed to get new coils and completely rewind the unit. This was out of the question at the time so we developed a unique method for operating with 28% of the coils disconnected.

First Failure. When trouble hit, differential relays operated removing unit from the bus and, at the same time, carbon dioxide was shot into generator. Because of fast relay action there was no appreciable iron damage. Likewise, resulting fire damage was held to a minimum.

Windings of all our station generators are wye-connected. Generator neutrals are tied into a common neutral bus through a circuit breaker. This bus in turn is grounded through a 2.5-ohm resistor. Machine that failed is totally enclosed and cooled by blowers and standard water heat exchangers.

Extent of Damage. After looking the generator over we found the point of failure in one of the top coils. Slot involved was in the lowest portion of the stator at exciter end of the generator. Fault arc was so bad a 2-inch portion of the affected coil had disappeared completely. As luck would have it no appreciable damage was done to the coil directly below the coil in trouble. Likewise, there was no damage evident on the stator frame. Faulty coil was next to the line end of winding.

Close examination of stator winding showed it was in generally poor condition. There was evidence of severe corona damage in addition to signs of overheating. This last conclusion came about when we found large amounts of compound had migrated to the extreme ends of coils. With all this information before us we concluded this particular failure was caused directly by a turn-to-turn short circuit, and indirectly by deterioration of winding insulation resulting from heating and corona. We knew in the long run the machine would have to be rewound. Yet, because station capacity and time were at a premium we resorted to a temporary repair and put off the complete overhaul till the unit could be conveniently spared.

Temporary Repair. Machine was originally wound with a 5/7 pitch. Seven coils were connected in series with four series groups in parallel per phase. This gave a total of 84 coils. After the manufacturer's engineers examined the machine they vouched for the unit's satisfactory operation at a reduced voltage with one coil removed from each series group.

Hence, with an original rating of 13.2 kv for seven coils, six coils would normally develop 11.3 kv. Following this line of thinking we cut out 12 of the 84 coils, once again regaining a balanced winding, Fig. 1. Naturally the defective coil was in this group that was cut out and insulated at both ends.

All in all the temporary repairs took

four days to complete. Machine windings were given a high potential test before returning it to service—12.5-kv dc phase-to-ground and 25-kv dc phase-to-phase for one minute. Once back in service the machine was tagged with a temporary rating of 12 kv max, 38,000 kw and 95% pf.

Parallel Operation. Since machine output is normally fed into a 13.2-kv bus, some provision had to be made to parallel this generator successfully with the 13.2-kv station bus. On the surface it appeared that fate was on our side since all power generated in this station is transmitted over high-voltage lines. Advantage was taken of this fact by feeding output of the repaired unit directly into a 60,000-kva 13.2/66-kv transformer bank. Maximum ratio of the bank was 13.2/77.2 kv. High-voltage side of the bank was tied directly to an overhead transmission line of 60,000-kva capacity. But, before connecting with the rest of the system, the generator output was transmitted to another station 24 miles away. It was this distance that proved to be a temporary stumbling block; the distance was too great, preventing generator from taking the desired reactive power.

OUR SOLUTION

High side of the generator's 60,000-kva transformer was previously connected in wye and grounded through a 30-ohm resistor. To boost sending voltage, the 30-ohm resistor was removed and a boosting transformer bank slipped in place in the neutral leads. This new transformer bank was rated 3000 kva. 13.2/4.3 kv, but was connected for a ratio of 11.8/4.3 kv. High side of the boosting transformer was connected to low-voltage terminals of the main transformer bank. The low side tied into the neutral terminals of the main transformer, Fig. 3.

At no load the resultant maximum voltage was 74.5 kv. Addition of boosting transformer bank did the trick, allowing loading of repaired machine to its full temporary rating.

Second Fault. About two months after the repaired generator was restored to service, we ran into a heavy ground fault on our 66-kv system. This was traced to an ox crane boom swinging into an overhead transmission line. Our repaired generator failed simultaneously with this fault. Once again the differential relays operated to trip the machine off the bus and release carbon dioxide into the machine. As with the first failure no appreciable damage to iron resulted and damage from fire was held to a minimum.

A quick examination showed another stator coil had failed. Once again it was the top coil in the slot but about five slots removed from where the first failed. This faulted coil was in the same series coil group as the first. Only this time the bad coil was the second from the neutral end of the winding.

New failure occurred at a point about 4 in. from slot end. Damaged coil was burnt through and a portion of its end turns dislodged. No real damage was done to any of the other coils.

Once again the manufacturer's engineers were called in. They suggested removing another coil from each series group. Thus 12 more coils were disconnected and insulated at both ends as shown in Fig. 2. Naturally the stator winding was high-potted again, this time with 10.4-kv dc phase-to-ground and 20.8-kv dc phase-to-phase for one minute.

Another Transformer Problem. Now with two coils removed from each series group, the remaining five coils would develop 9428 v normally or 9899 v at 105% normal voltage. Under these temporary conditions the machine was rated 10 kv max, 33,500 kw and 96% pf.

The big headache now was to get sufficient transformation to match the output voltage to the rest of the system. The small booster transformer used after the first failure was not suitable with the generator operating at 10 kv.

After searching around we came across a spare 20,000-kva 3-phase 66/13.2-kv transformer in one of the outlying substations. To use it we connected the 66-kv windings in delta and the 13.2-kv windings in wye. We went ahead and used this transformer as a booster, energizing the 66-kv windings from the high voltage side of the main transformer bank. The 13.2-kv winding was hooked in on the neutral, as shown in Fig. 4. Once again the reconnected generator was put back in service. This time it was just eleven days after the machine had failed the second time.

In the back of our minds we felt that excessive field heating might develop. This was in view of the unsymmetrical nature of the reconnected generator winding, although as time went on no trouble was encountered on this score.

WAS IT WORTH WHILE?

The generator worked well at this reduced voltage. Only a short while ago the stator coils arrived that were ordered after the first failure. The machine is now out of service for rewinding and we estimate this will take about four weeks.

By using all the tricks of the trade it was possible to salvage 74.5% of the generator output for a period of six months. Remember, since these failures occurred in the low-pressure unit its operation on a temporary basis also permitted use of the associated high-pressure turbine-generator unit. Under normal conditions, capacity of the high-pressure generator is 16,000 kw. Because of the loading restriction placed on the repaired generator it actually delivered about 12,000 kw. In reality the actual capacity for these temporary connections was 45,500 kw, or 74.15% of the rated output.

Now that the job is a thing of the past the costs involved were really of secondary importance. Even considering the cost of temporary generator repairs plus the cost of moving and installing booster transformers, the money spent is justified considering generating capacity was at a premium.

Wiring Change Prevents Machine Trip-Outs

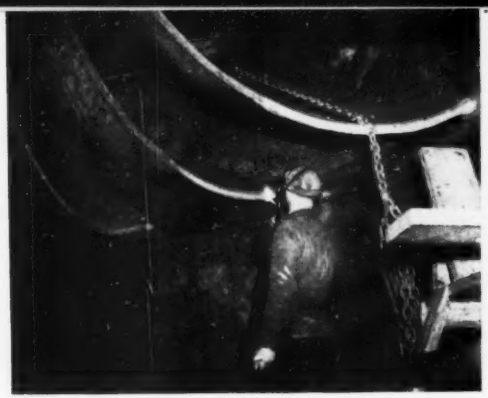
► FIELD-TEMPERATURE RECORDERS on large synchronous condensers have a 2-fold job. First they make a running record of field temperature. On top of that they have a set of contacts to trip the machine off the line if the field overheats. These contacts are exposed and can be accidentally closed when the main mechanism is swung out of the case.

Actually, it is only necessary to swing out the chart-holding portion of the mechanism when changing charts. Nevertheless, some operators have the habit of swinging out the main mechanism. As a result several accidental trip-outs have occurred.

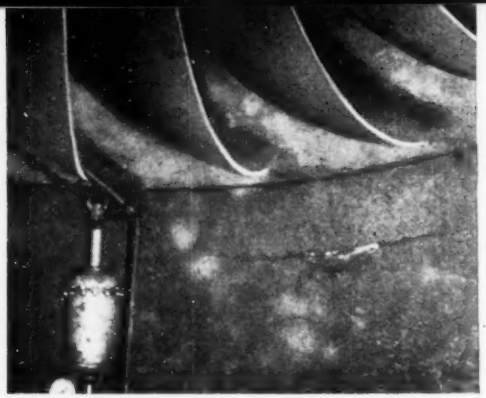
You can avoid such outages by a simple wiring change. Instead of having both motor leads running through the two-pole switch, tie the grounded neutral through solid. Connect the now spare switch leg in series with field tripping circuit. When the switch is now flipped the recording motor stops and trip circuit opens.

You can still run into trouble even with this hookup if you're not careful when snapping the switch back on. Make sure the pen is below the tripping point (usually 120 C) before returning switch to *ON* position.

H C BARNES *American Gas and Electric Service Corp, N.Y.C.*



1 Scaffold swung from chains hooked around outer edge of the buckets provides working space for ladders, needed tools



2 Cavitated areas chipped and grit-blasted, ready for the spray. Properly blasted surface displays dull gray color

Metal Spray Repairs Hydraulic Turbine

► Of the different methods for repairing cavitated hydraulic turbine runners, arc welding is probably the commonest. Once in place, stainless-steel deposits resist cavitation, and don't come out.

Some companies have tried welding stainless-steel plates over the cavitated areas after filling them with some other metal. That hasn't worked too well. For one thing, it's hard to form a spot to the proper contour.

Sprayed Metal. Of the many plants that have tried metalizing, some have been quite successful while others failed. Every failure studied showed the cause to be either (1) improper preparation before spraying, or (2) using a sprayed metal that couldn't possibly stand up.

Companies using metal spray to repair cavitation damage to hydraulic turbine runners have developed methods that really do the job and keep sprayed metal in place. Here's how one company repaired a 57,000-hp unit.

Six Hours for Rigging. A crew of nine men was put on the staging operation. Hooks were fastened over outer edge of buckets, Fig. 1. Chains from hooks supported timbers in the draft tube, and planks were spiked across timbers. Platform was completed and ready for use in six hours.

Drying. The next problem was drying the blades. A 22-kw motor-driven transformer drier was set up to provide heat. Two 600-cfm low-pressure fans were arranged to circulate the air and remove burned gases and metal dust. This setup ran for several hours and took care of a good deal of the moisture. Local heating with acetylene torches did the rest of the drying.

Chipping. Here, and in the next step, is where technique is important. What comes out of a metalizing gun is tiny molten particles of metal. They're still molten when they land, but because the surface they land on is cold, they cool and solidify almost immediately. That's why they must have something to key themselves into—hooks and tears that they can wedge into before they lose all their heat.

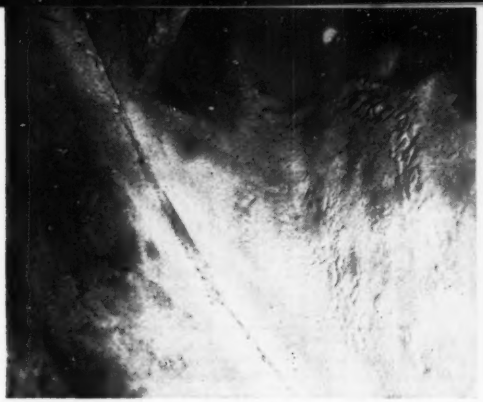
Offhand, you might think that the honeycombed metal in cavitated areas would provide all kinds of anchorage. It would if it were strong enough to stand up for any length of time, and had no other drawbacks. This company's engineers and workmen found out quite a bit about honeycombed metal: (1) It's weak and sometimes gives way after the sprayed stainless steel is in place. (2) The honeycomb causes a very irregular sprayed coating that's difficult to grind. That's because the spray builds up on the high spots as well as in the low ones. (3) The coating bridges over in some places, while in others it leaves spots that are unprotected or insufficiently coated so water can eat in under the rest of the coating. In other words, there are three good reasons for getting rid of the honeycomb before metalizing is started.

Removed Honeycomb. So, on the 57,000-hp unit, the workmen took automatic chipping hammers and cut out almost all this material. They didn't go to the bottom of every pitted hole. They just took out enough of the rough metal to leave a cavity more or less saucer-shaped with the bottom fairly smooth. It was worth the time to do it, because there was a great deal less grinding after the coating went on. In fact, the company found that a good metalizing operator could build up a coating so near the desired contour that almost no finishing was necessary. It also got away from holes in the coating and bridging, and left a coating of fairly uniform thickness all over the bad sections of the blades.

Grit Blasting. Next step was to grit-blast the buckets. A pressure-blast generator was brought as close to the work as possible and the blast hose run in to the workmen. A 5/16-in. nozzle and G-16 angular steel grit were used with 100-psi air pressure. Grit was gathered from the platform and reused only as long as it remained sharp—generally three or four times—after which it was dumped and new grit put in.

Blasting was done only on the number of buckets that could be sprayed by one shift. That's because grit-blasted surfaces stay clean and free from oxides only about four hours. Blasting was continued on each blade until it was absolutely clean and well roughened over the surface to be coated. It was carried well out over the edges of the chipped cavities, to at least six inches all around. Reason for that is to allow the sprayed metal coating to be feathered off into the original contour. It also gives some protection to the blade beyond the areas originally cavitated.

Surface Finish. Wherever possible, blasting nozzle was held as nearly as possible at right angles to the work. This allows the grit to cut better. A more acute angle makes the grit polish instead of cutting. You can tell good



3 Spraying operation completed, blade is ready for grinding. Small amount of excess metal occurs at edges of the cavity

4 Grinders are heavy. Workmen must be able to take a position that isn't too tiring. Use ladders, tool rests, etc

If you have had trouble getting sprayed metal to stand up on turbine blades, you may find the answers in this application procedure outlined by John E Wakefield

blasting from its appearance. Dark spots mean there is still dirty metal on the surface, spots which the grit hasn't touched. Bright spots are polished instead of roughened. A properly blasted surface has a uniformly dull gray color. Remember, you're not only cleaning; you're roughening as well. Fig. 2 shows some of the blades blasted and ready for the spray.

Blasting is the most important part of the job. The surface must be clean or the metal won't stick properly. That's true with any process for bonding, joining or adding metals. Metalizing is no exception. The surface must not only be rough; it must have the right kind of roughness. Good blasting does both jobs. If it's done right, you've got the bond you need for sprayed metal. If not, the coating can loosen and come away. Take time to do it right. If you're not sure it's right, do it again.

Stainless Steel. Selection of metal to be applied is also extremely important. By trying different metals, this company found out that medium-chrome medium-carbon stainless steel is the best by a wide margin. In addition to the advantages already pointed out, it's a "low-shrink" metal. It doesn't contract much when it cools and, therefore, doesn't place a high shear stress on the bond. That means heavy coatings can be built up without danger of cracking or weakening the bond.

Coating Operation. In this plant two or three blades were worked on at the same time. This kept the coatings fairly cool—never more than warm to the bare hand. Coating was carried about four inches over the edges of the cavities and stopped at least two inches inside the edge of the blasted area. Metal was feathered to nothing at this point to tie into the original contour. Fig. 3 shows one of the blades sprayed and ready for grinding. Note that excess of sprayed metal occurs only at the cavity shoulders. This is bound to happen because it builds up as much on top of the shoulders as below them. It does no harm since the blasted surface and the bond extend well beyond that point. It does, of course, add something to the grinding, but that's unavoidable because you need a smooth finish.

Gun Angle. In spraying the surface, the gun was held about 6 inches away —the correct distance for this type of gun using ⅛-in. wire. Gun was held as nearly as possible at right angles to the blade surface, as in Fig. 1. Angles less than 45 deg should be avoided at all times because a poor coating results, open-grained and very porous. On this runner, there was space enough to spray at 90 deg almost everywhere. In smaller units where areas are not accessible, an extension must be used on the gun.

Note that the operator in Fig. 1 is wearing a force-feed mask. It's a good idea. Sprayed stainless-steel dust is irritating and a mask overcomes this problem very easily. A mask has to be worn for blasting anyway, so one is always on hand.

Grinding. After coating was completed, grinding was started. Both electric and air-type portable grinders were used. Fig. 4 shows one of the men working from a ladder, which stands on the platform and leans against the blades. This gave the operator good support and brought him near the work.

This particular unit was taken out of service at midnight. Just after noon on the tenth day following, it was back in operation. Service experience has been highly satisfactory. The job took about 425 lb of stainless steel—81 lb of it going on one blade.

Main problem in grinding is to avoid overheating. If you want to prevent this don't try to remove the metal too fast. Sprayed metals fill up wheels faster than other kinds. For that reason, it is best to use a wheel of fairly coarse grain and low bond-strength, and dress it often. Use a fairly coarse grain on disk grinders.

Precautions. Most of the important points have been covered already in the job description or recommendations. Just for clarity and review, here they are again:

1. Dry the surfaces thoroughly.
2. Chip out most of honeycomb.
3. Blast thoroughly. If you're not sure it's blasted enough, go over it again.
4. Carry blast six inches over cavity edges.
5. Spray hard stainless steel, preferably medium-chrome medium-carbon.
6. Adjust flame of gun before adjusting wire speed.
7. Stop coating, and feather off inside of blasted area.
8. Don't overheat in grinding.

Drying, cleaning and roughening are all mighty important. One job that was witnessed employed a blower set-up pouring outdoor air into the turbine. It was done in the summer so air was warm and dry.

Electrical Distribution

There are not many systems to choose from once you have all the facts. Here's the breakdown outlining the five found most practical, along with list of points to check when considering new layout*

FLEXIBILITY AND SERVICE CONTINUITY ARE FOREMOST

► RECENT DEVELOPMENTS in basic system designs along with improved equipment have made a number of electrical-distribution systems available. While some variations are usually necessary in individual cases, there are at present nine forms of industrial-distribution systems. They are: (1) simple radial (2) loop-primary radial (3) primary-selective radial (4) secondary-selective radial (5) banked-secondary radial (6) simple network (7) simple spot network (8) primary-selective network (9) primary-selective spot network.

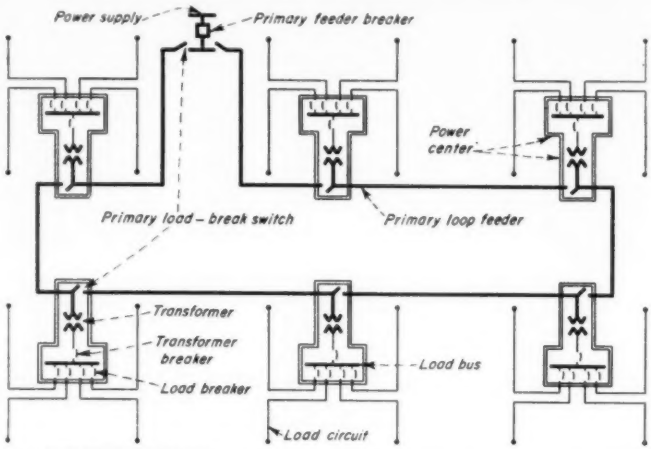
Following six points should be kept foremost in mind when measuring effectiveness of any electrical-distribution system: flexibility, service continuity, voltage regulation, efficiency, operation and maintenance cost, initial investment. After putting these six yardsticks to work, five of the nine basic systems are found to be outstanding. These five are discussed in detail.

Simple-Radial System. Conventional simple-radial system was used generally in industry until about 1940. Briefly, this system has a single transformer substation to step-down supply to utilization voltage. Long low-voltage feeders carry power from this main substation to switchgear at load centers throughout the plant. This system is usually quite expensive in plants having loads over 1000 kva and covering a large area. This can be traced to investment in copper and need for controlling main feeders with relatively large and costly low-voltage circuit breakers.

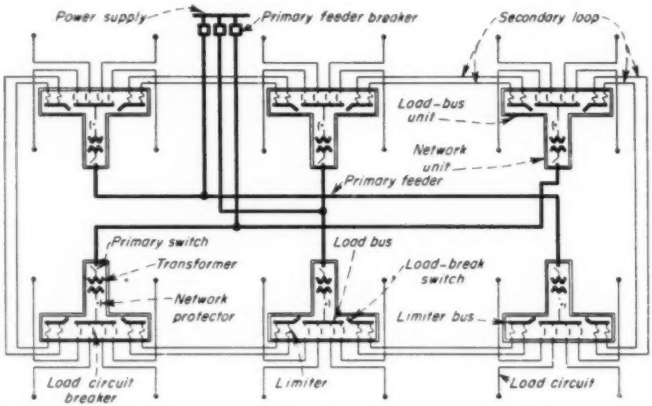
Other inherent disadvantages of the conventional radial system are low efficiency, excessive regulation with poor voltage conditions at loads, and low service reliability. It is possible to overcome most or all of these disadvantages by using one of the five popular modern system arrangements. All modern systems avoid the bad features of long, heavy, low-voltage feeders by carrying power to load centers throughout at the primary distribution voltage.

Modernized form of simple-radial system uses a single, radial-primary feeder supplying a number of small secondary substations at load centers. This system overcomes some of the disadvantages by distributing power to the load centers at high voltage. As a result, regulation and efficiency are considerably improved. This system is usually the lowest in initial cost compared to any of the major systems for plants having peak loads greater than about 1000 kva. It is also the poorest in flexibility and service continuity.

Loop-Primary Radial. Fig. 1 shows one of the five modern arrangements called the loop-primary radial system. As its name implies, a circuit in loop form operating at primary voltage car-

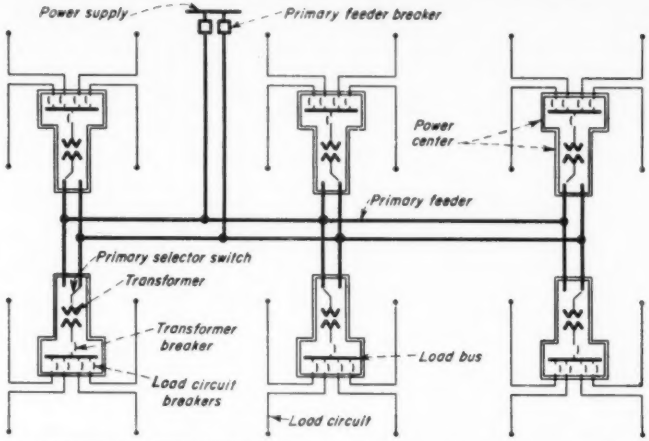


1 LOOP-PRIMARY RADIAL system is a marked improvement over conventional single substation. This shows up in better voltage regulation and low operating cost

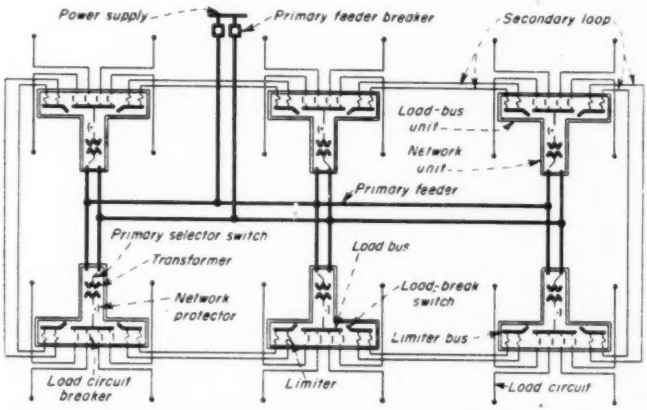


3 SIMPLE NETWORK system has secondary loop that tends to equalize loading on all network units regardless of load being supplied from a particular substation

* Based on paper presented by Harry B. Thacker, central station engineer, Westinghouse Electric Corp., East Pittsburgh, Pa., at the 11th Annual Midwest Power Conference.



2 **PRIMARY-SELECTIVE RADIAL** system is designed so when one primary feeder is out of service the one or more remaining feeders will handle entire plant load



4 **PRIMARY-SELECTIVE NETWORK** is in general use in smaller plant. It is the lowest cost network for plants where not more than two or three feeders are required

In Industrial Plants

ries power through the plant. Primary loop is fed from incoming source of supply through a high-voltage circuit breaker. Loop is usually sectionalized with manually operated, load-break switches. There are two such switches, just beyond the high-voltage breaker where feeder branches out to form the loop, and one at each load center.

Primary voltage is stepped down to utilization voltage at each load center. Transformer secondary then supplies load bus through a main secondary breaker. Low-voltage feeder circuits radiate from this bus through individual feeder breakers. In the modern installation these secondary substations generally have a transformer with built-in primary switch. In addition, there is usually a drawout-type low-voltage metalclad switchgear, in the form of a factory-built power-center unit. Each power center in the loop-primary radial system must have enough transformer capacity to carry peak load of its area. This system is lowest in initial cost among the five high-rated systems.

Since power is distributed to power centers at high voltage, the loop-primary radial system shows a marked improvement over the conventional single substation radial system. This shows up in better voltage regulation and efficiency, in addition to costing less to operate and maintain. It is weak, however, from the standpoint of flexibility. Then, again, any major change in plant layout, such as the movement of certain loads from one part of the plant to another, may require costly changes in this distribution system.

From the service-continuity angle the loop-primary radial system shows some improvement over the modern simple-radial arrangement. But it is the poorest of the five selected systems in this characteristic. A fault occurring in a transformer or at some point in the primary loop will open the main feeder breaker and interrupt service to entire load supplied by loop. When fault is located, the faulty loop section or transformer can be disconnected from the system by opening the adjacent load-break switches. Primary breaker can then be reclosed and service restored to all but the loads in the area supplied by the faulty transformer or loop section. Of course, these loads will be shut down until repairs are completed.

Primary-Selective Radial. Another form of radial system is shown in Fig. 2. It uses a duplicate feed to the primary sides of secondary substations or power centers. Called the primary-selective radial system, it is designed so if one primary feeder is out of service the one or more remaining are capable of handling entire plant load. Two or more primary feeders, each controlled by a high-voltage feeder breaker, are carried throughout the plant. By means of a primary selector switch the substation transformer can be connected to either primary circuit. Normally, if two feeders are used, half of the transformers are connected to each feeder.

This arrangement results in some improvement in service continuity over that of the loop-primary radial system. A fault in either primary feeder causes the associated feeder breaker to open. In the usual case this means an interruption in service to about one half of the plant load rather than that of the entire plant. Service can be quickly restored to all loads after a feeder fault, by switching the deenergized power centers from the faulty to the good feeder.

From the angle of flexibility, efficiency, regulation and cost of operation and maintenance, the primary-selective radial system does not differ to any degree from characteristics previously pointed out for the loop-primary system. Initial cost of the primary-selective radial system is usually slightly higher because of the additional primary breaker and high-voltage feeder cable required. Often the reduced extent of service outage for faults in the primary-selective radial system justifies this small difference in cost.

Principle of duplicate feed is carried through to the secondary sides of load-center units in the secondary-selective radial system. As in the primary-selective radial system, two or more primary feeders are carried throughout the plant. Each secondary substation consists of two transformers supplying individual sections of low-voltage bus, each through its own main secondary breaker.

Load feeders supplied from each secondary substation are divided between the two bus sections. Every feeder connects to its designated section through a low-voltage feeder breaker. Bus-tie breaker in each substation connects the two sections of load bus. To minimize the short-circuit duty on load feeder breakers, each secondary substation is normally operated as two independent units. The bus-tie breaker is normally open and is interlocked with the two main secondary breakers. Hence it cannot be closed unless one of the two main secondary breakers is open. This is an important point.

BANKED-SECONDARY RADIAL

There is one form of radial system that can inherently furnish a high degree of flexibility while providing for quick restoration of service to all loads following a primary feeder or transformer fault. The banked-secondary radial system is similar in arrangement to the loop-primary radial system. Difference is a secondary loop between load center units providing an emergency supply when a transformer or primary cable section fails. Each loop section usually consists of two or more cables per phase. They connect to load buses in adjacent units through load-break switches and limiters.

The limiter is a fault-protective device consisting of an enclosed fusible element. One of the advantages of loop-secondary is it's unnecessary to fit installed transformer capacity to load at each load-center area. This is logical since help from adjacent units is made possible by secondary loop. A common transformer size is used throughout the system, allowing low-voltage feeder circuits to be run directly from nearest load bus. All these points are effective in improving flexibility.

Initial cost of this system is generally higher than other radial systems with exception of secondary-selective radial idea. In plants having appreciable peak load diversity between load-center areas, cost of secondary loop may be offset by savings in transformer capacity resulting from all units being paralleled on secondary side. Load-feeder circuit breakers in the banked-secondary radial system may require a higher interrupting rating because of the many sources of fault current made available by secondary loop. In general, cost of this system is comparable to the secondary-selective radial system. Advantages are greater flexibility, higher efficiency and reduced operating and maintenance costs, along with good voltage conditions and fair service continuity.

Simple Network System. Two or more primary feeders supply network substations throughout plant in the simple network system, Fig. 3. Each feeder is controlled by a high-voltage circuit breaker at primary substation. Network substations consist of step-down transformer, high-voltage disconnecting switch, low-voltage network protector between transformer and load bus, and low-voltage feeder circuit breakers. A secondary loop, identical to that described for the banked-secondary radial system, connects load buses of adjacent network substations.

Loop used in network system provides the same advantages that were pointed out previously. It furnishes an alternate source to any load bus when the primary feeder and transformer normally supplying that bus are deenergized. It makes a greater amount of transformer capacity available for handling suddenly applied loads, such as across-the line starting of relatively large motors. This available transformer capacity makes it possible to supply both lighting and power loads from the same load bus. Secondary loop tends to equalize loading on all network units connected to it regardless of actual load being supplied from a particular substation. This factor usually permits a common-sized transformer to be used throughout. It also tends to minimize required amount of installed capacity in plants when there is diversity between load-center areas.

A primary feeder or transformer fault in the simple network system is automatically isolated from the system with no resultant interruption of service to any load. Feeder or transformer fault is isolated when associated feeder breaker and network protectors operate. Units remaining in service after a fault absorb load of the deenergized units with no service interruption. Network protector consists of a specially designed automatic air circuit breaker with a closing and tripping mechanism controlled by reverse power and phasing relays.

Simple network system is similar in many respects to banked-secondary form of radial system. Chief difference lies in the greater service continuity of network system.

Primary-Selective Network. Fig. 4 shows a form of network system that has been most generally used. It is the lowest-cost network system for plants where not more than two or three primary feeders are required. The primary-selective network system was developed to extend economically advantages of network distribution into the range of small and medium-sized industrial plants.

Network substations in this system use a high-voltage selector switch. By means of this switch the transformer can be connected to either of the two available primary feeders. This primary circuit arrangement is identical with that of the primary-selective radial system. Load-bus arrangement and secondary loop is similar to that described for the banked-secondary radial and simple network systems.

NETWORK COSTS

Operation of primary-selective network under primary feeder or transformer fault conditions is the same as in the simple network. This is so since no service interruption occurs during automatic isolation of a feeder fault; plant load is carried by units remaining in service. But the deenergized transformers should be switched to the good feeder after a primary cable fault. This primary-selector switching operation, performed within about an hour after fault occurs largely eliminates the need for spare-transformer capacity.

Transformer fault in network system is isolated in a manner similar to a primary feeder fault. Faulty transformer should be disconnected from deenergized feeder by high-voltage switch. Then the feeder can be energized with all its associated transformers, except the faulty one, returned to service.

Cost of primary-selective network system is comparable to secondary-selective radial system. Cost difference depends to a large extent on amount of diversity between the various load centers. For plants having a high diversity factor (radio of sum of individual maximum demands on various load centers to maximum demand of whole system) between load centers, the primary-selective network is usually the least costly of the two systems.

DELEGATES at National Association of Power Engineers' convention have their picture taken with the Ladies Auxiliary

NAPE Attacks Air-Pollution Problems

► AT THE HOTEL SHERMAN, Chicago, Ill., the National Association of Power Engineers held its 66th annual convention and National Power Show, during five days, Aug 22 to 26. About 200 delegates, 3500 members and other engineers, and 500 manufacturers' representatives registered. Both the convention and power show were among the most successful held by the association. Meetings and the show were well attended.

First Session. The first meeting, called to order by Leland J Mamer, general chairman of the convention committee, featured addresses by Oscar E Hewitt, Chicago's Commissioner of Public Works; Clifton R Harding, national president, NAPE; Glen E Copeland, national vice-president; Stephen C Casteel, past president. Joseph O'Connell presented the gavel to National President Clifton R Harding, who afterwards presided at all meetings. In addition to presenting the many association reports and handling the other problems that came before the convention there was a well-rounded program of lectures and educational movies.

Educational Program. Movies shown were: "Trapping for Profit," Armstrong Machine Works; "Steam for Power," Babcock & Wilcox Co; "Steam Progress," Combustion Engineering-Superheater, Inc; "Life Lines of Industry," Crane Co; "Methods of Cleaning Coal," Link-Belt Co; "From the Ground Up," Plibrico Jointless Firebrick Co; "Prospecting for Petroleum," "Birth of an Oil Well," "Lever Age" and "Harnessing Liquids," Shell Oil Co; "Gasoline's Amazing Molecules," and "Lubricating Oil's Amazing Molecules," Standard Oil Co (Indiana); and "Silver Brazing Techniques," Walworth Co.

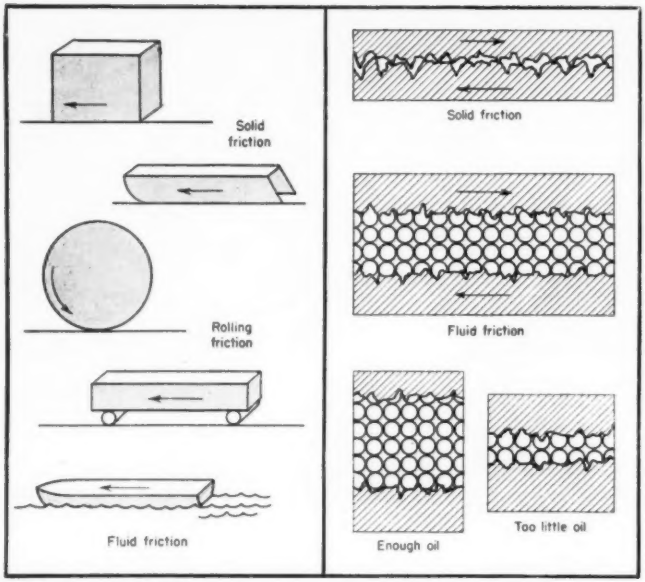
GLEN E COPELAND, newly elected president, NAPE; St. Paul, Minn. Chapter 7

Power Show. The National Power Show held in conjunction with the convention was a highly successful feature of the program. Representatives of 65 companies were kept busy explaining their products to the large attendance. Several large pieces of equipment featured this year's show. Among them were a full-sized vibrating car shaker, demonstrated by a large working model; a forced-circulation package boiler; a hydraulically operated spreader stoker for a 50,000-lb-per-hr boiler.

Air Pollution. With Arthur Perlinger acting as moderator, Tuesday afternoon's session was devoted to many air-pollution and smoke-abatement problems and their solution. Papers presented were: "The Administration of Air-Pollution Legislation, by Harry J Harp, assistant chief of air-pollution control, Philadelphia, Pa.; "The Part That the National Association of Power Engineers Must Take in the Formation of Smoke-Abatement Legislation," by Thomas J Barrett, chairman of the Metropolitan District Committee of New York City, NAPE; and the "Engineer's Place in Smoke-Abatement," by H B Lammers, chairman, Coal Producers Committee for Smoke Abatement. In the absence of Mr. Barrett, his paper was presented by Past National President H W Wilds.

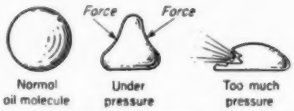
Presentation of the papers challenged the NAPE members to take a more active part in directing air-pollution legislation and its enforcement. During the discussion much concrete evidence was presented of the constructive work by several chapters in helping to enforce smoke-abatement legislation intelligently. In several cases NAPE committees helped plant owners set up correct steam-plant operating programs.

Elected Officers. At the final business session Glen E Copeland, plant superintendent, State Capital Building, St. Paul, Minn., was elected national president for the year 1949-50. For the same period Guy L Warden, consulting engineer, Los Angeles, Calif., was elected vice-president. A F Thompson, room 1736, 176 W Adams St, Chicago, Ill., was re-elected national secretary and elected treasurer, the two offices being combined into one. Next year's convention will be held in St. Louis, Mo.



FRICTION IS REDUCED between two bodies by using rolling or fluid medium

OIL MOLECULES act as ball separators changing friction from solid to fluid



EXCESS PRESSURE squeezes or crushes the oil molecule when too-light oil is used

Review of lube fundamentals starting with friction, how it's reduced by lubrication, and what goes into typical lubricant. Brief reference to a refinery distillation shows how lubricants are produced

How Lubrication Licks Friction

► ABOUT 60 YEARS AGO men began to study lubrication as a science. Their progress, although slow, has kept modern machinery operating. Build as elaborate a machine as you wish and power it as you will, if you can't lubricate it, you can't keep it going.

Friction. A man walks, a belt pulls, an automobile moves with the help of friction. Without it man couldn't exist. It is also one of his greatest problems, for whenever two surfaces slide over one another there is friction, bringing with it wear, heat, shortened life, and need for lubrication.

The boys of old first began to learn about friction when they tried to wall in their caves. A square block was difficult to push, but a round boulder rolled easily. A block that two men found almost impossible to drag or push was rolled easily by one. And when the same log was put in water, it was child's play!

At the time, cave men didn't know they had discovered one of the basic laws of friction; namely, that sliding friction between solids requires most power, rolling friction less, and fluid friction least. By converting from solid to fluid they saved power. They noticed that dragging the log along the ground made the ground warm. But they didn't understand that sliding friction produces most heat, rolling friction less, and fluid friction least of all.

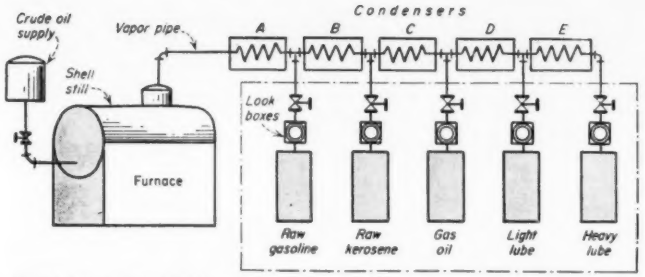
They found that a body difficult for two men to start could be kept moving by one—another of friction's basic laws. We know now that friction at rest is much greater than friction in motion. Then, again, they knew that to get a fire from one of their crude bow drills they had to keep it free of animal fat. Why? Because, when dry, its rotation produced sliding friction, generating the most possible heat. A little fat converted it to fluid friction and little or no heat was generated. They used that same principle in greasing skids. But they didn't realize that in so doing they were heading toward modern principles in lube practices.

Man gradually learned to grease axles and to lubricate pivots and sliding shafts. But he didn't know exactly why he did it. As he learned more about lubrication he found shafts could take more load, piston clearances could be smaller, and surfaces more accurate.

What Is Lubrication? No matter how carefully a surface is machined or ground, it is full of hills and valleys. If you take a piece of steel and rub it against another, hills in one piece fit into valleys in the other, pits in one fit over peaks in the other. The two pieces tend to stick together like a pair of files with ultra-small teeth. To make one piece pass the other, we must separate them enough so hills in one slide past those on the other. One way to do this is to provide balls or rollers to avoid the sliding.

In a nutshell, that's about the simplest way to describe what a lubricant does. Actually, the mechanism of lubrication is quite complex; the academic theory is not yet fully understood. For our purpose, though, picture several rows of infinitely small balls between the steel pieces. One row of balls fills the holes on one piece, while another row fills those on the other. Then the rows in between roll easily over one another; no jagged peaks or deep valleys now! But the balls, instead of being steel, are oil molecules.

Why does oil do this? Now is the time to introduce those two common



CRUDE-OIL DISTILLATION is first refining process. Vapors are passed through a series of condensers each at different temperatures. First is the hottest

terms, cohesion and adhesion. The two pieces of steel, when rubbed together, have a lot of cohesion. That is, molecules on each piece like to stay together and resent being shoved around. That's true of any solid. But any body with high cohesive power usually has little adhesive power, and vice versa. Mucilage, for example, hasn't very much cohesive power unless it's frozen. But it does right well as an adhesive. Oil is somewhat the same. It has high adhesive qualities—likes to stick to steel. But it has low cohesive qualities—doesn't mind being shoved out of shape. So oil properly adheres to steel on both sides and its molecules roll over one another like so many marbles.

Of course, it's possible to put so much pressure on these marbles that they are squeezed out at the sides, or crushed. That's where selection of a proper lubricant comes in. You simply provide a "harder" oil; one that resists deformation more; one that has a little more cohesion. And eventually you'll get those two steel surfaces separated by a film of fluid that floats each on the other, as boats float on water. That's fluid friction—least wear on parts because less heat-and-wear-making power is required to move one over the other.

Lubrication Engineer. All lubrication isn't as simple as that—proper cohesive and adhesive relationship of lubricating film and proper distribution of pressure between rubbing bodies are only two factors. Sometimes, as in a diesel cylinder, there is heat to remove. Sometimes, as in a steam cylinder, there may be moisture or water that likes to work its way between oil and steel. Sometimes, as in a machine bearing, there may be fine metal chips or other contaminants trying to work their way in. But lubricants worthy of the name can be prepared to meet any condition.

When you run into a problem that's too difficult, that's where the lubrication engineer pulls his share of the load. He begins the process of cutting the cloth to fit the suit—a little of an oil that has this desired quality, and a little of an oil that has another desired quality. The mixture is not so good as either of its parts in that part's specialty. But it has some of the qualities of each one. By such blending of mineral oils alone, or compounding with animal or vegetable fats, your lubrication engineer produces an oil that does your job. He produces a lubricant that stays in place under pressure, provided there are the necessary molecular layers to give good "rolling" of one layer on another. And yet this blended oil has the characteristics necessary to meet the special conditions of surfaces, speed, clearances and load.

Of course, the proper lubricant may not be an oil—it may be a grease or a solid lubricant, depending on the particular set of conditions. Essentially, a grease may be considered to act just like an oil, except it has more "body." But a common lubricant like graphite is really a lot of tiny smooth scales that fill in the valleys, then slide over each other as smoothly as a sled runner glides over ice.

Lubricant Types. There are three types of oils: animal, vegetable and mineral. In recent years there has been widespread interest in various types of synthetic oils and lubricants. These synthetic products may be roughly classified into two distinct groups. The first group is composed of synthetic hydrocarbons, and the second of nonhydrocarbon synthetics.

Mineral Oils. Petroleum or crude mineral oil is found in almost every country. Chief fields are in the United States, Venezuela, Colombia, Russia and Borneo. Crude is a complex varying with the field from which it comes in percentages of naphthenes, paraffins and aromatics. These are the three principal types of carbon-hydrogen combinations. By careful refining, manufacturers remove asphaltines, wax, free carbon and many other undesirable constituents.

There are four large oil-producing regions in the United States. So-called paraffin-base crudes come from the Pennsylvania fields. Mixed-base crudes come from the mid-Continent fields. Western and most foreign fields produce asphalt-base crudes. Most lubricating oils are now blended of various crude stocks to gain a preferred group of properties.

Animal Oils. Mineral oil is compounded with animal oils for steam-cylinder lubricants. These include tallow, lard oils and degras. Tallow oil is obtained by pressing beef or mutton tallow, lard oil by pressing pig fat. Degras is prepared from the grease in sheep's wool. Oil contains fatty acids and much oxygen in addition to the fundamental hydrogen carbon. Oils absorb more oxygen to dry out, and eventually turn rancid to form acids that attack metals. Tallow is used in white greases and as a saponified base to "hold" lubricating oil in a grease. Unrendered tallow—the familiar suet—sometimes lubricates badly worn open bearings. Lard oil is used in cutting oils, in some engine lubricants (to 10%) and in stainless oils.

Vegetable Oils. These are similar chemically to animal oils, although they usually dry more readily. Castor oil, best lubricant among them, comes from the seed of the castor shrub. It has the highest specific gravity and viscosity of any fixed oil. It lubricates heavy marine, airplane (particularly rotary), and racing automobile engines with extremely high bearing pressures. Castor oil does not mix well with mineral oil unless another fixed oil, such as lard or rape, is present. But all other fixed oils do mix with it, and have been so used.

Rape oil, used in railway and marine engines, soluble and quenching oils, is extracted from Indian and Russian rape seeds. Cottonseed oil dries too readily to make a good lubricant, but is sometimes an adulterant in other oils. It gives good "finish" for a cutting oil. Linseed oil, pressed from flaxseed, a drying oil, is useless as a lubricant.

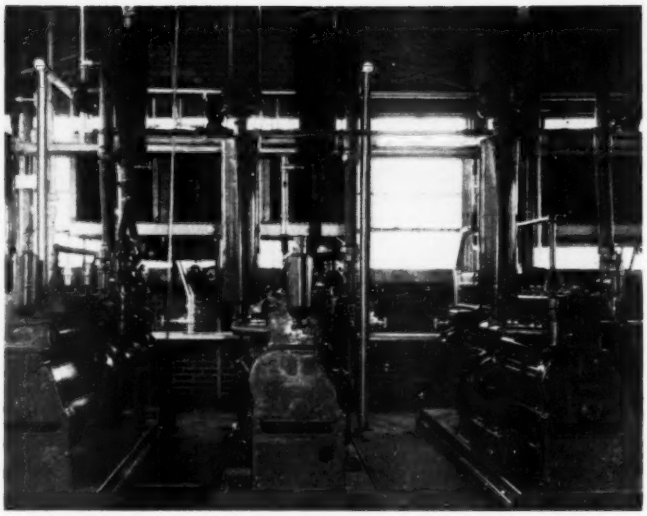
Olive oil, formerly a nonstaining lubricant in wool processing, has now been mostly replaced by mineral oil.

Solids. Graphite, talc, soapstone, mica, flowers of sulphur, white lead, and similar materials are also used as lubricants. Graphite resists pressure without breaking down, while amorphous graphite and flowers of sulphur break up.

Graphite, not attacked by acids, alkalies, or high or low temperatures, is a mineral. It is most important of all to solid lubricants. It is used ex-

(*Continued on page* 162)

Diesels, gas engines and air compressors all reject heat as part of their normal operation. Instead of being a liability, involving trouble and expense for dissipation, this heat can be recovered and converted into a worthwhile asset. J L Michener, plant engineer, Schramm, Inc, tells how . . .



ENGINE-DRIVEN COMPRESSORS do double duty in plant of Schramm, Inc, West Chester, Pa. Two of three 315-cfm units are diesel driven, one is gas-engine driven

Diesels and Compressors Team With

► ALL TOO OFTEN, engineers overlook the savings possibilities of waste-heat recovery from air compressors and their driving engines. That these savings can be worth while, and are frequently relatively easy to obtain, is demonstrated by experience in our own plant. Here we operate three 315-cfm compressors, two driven by diesels and the third by a spark-ignition engine using manufactured-gas fuel. At full load, each of these units will deliver about 400,000 Btu per hr into a system suitable for space or process heating.

Where Heat Goes. Before looking at the practical angles of such heat recovery, let's review briefly what happens to the heat units we feed into these machines. In the diesel, most efficient of commonly used prime movers, about one third of the fuel's energy shows up as useful shaft output. Most of the remaining two thirds goes out as heat in the jacket water and the exhaust. A small fraction is radiated from the engine frame and piping. The story is the same for the gas engine, except that less fuel energy is converted to useful work—only about 25%, on the average. Hence a greater amount goes out in jacket water and exhaust.

When we use diesel and gas engines to drive compressors, we run into a further loss of energy. The shaft output of the engine becomes the input of the compressor. Part of this input gets converted to heat in the compression process: just as a bicycle pump gets hot in use, so do the cylinder walls, valves and other parts of the compressor. Water in the jackets picks up this heat, in part. Some goes out with the compressed air, which has a higher temperature than the intake air. For efficient transmission and use we cool the compressed air in an aftercooler.

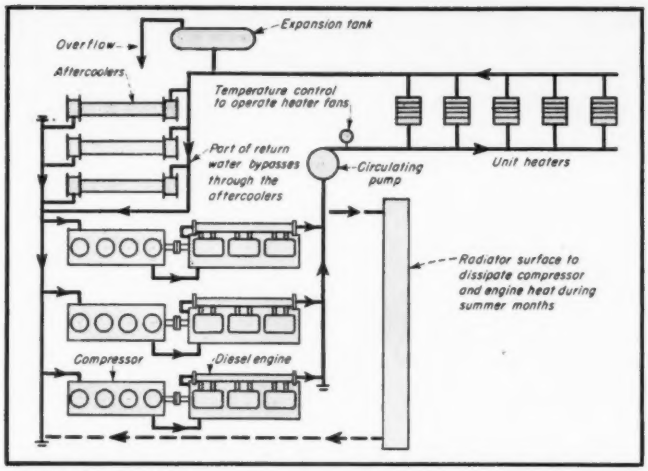
We can see that between the fuel we start with, and the useful compressed air we finish with, a good many Btu drop off along the line. Usually, we either install equipment to dissipate the heat—radiators, for example—or we let the Btu go their merry way—say, to the atmosphere with the exhaust gas. Yet wherever there is need for space or process heating, at temperatures up to about 180 F, we can salvage a good part of this heat. The trick lies in making sensible arrangements for heat recovery, so that cost of heat-recovery equipment doesn't eat up most of the fuel savings that result.

Teamed With Unit Heaters. In our case, we teamed the engine-compressor units with unit heaters, as shown in the diagram, p 101. As a first step, we equipped the engines with marine-type watercooled manifolds. Water coming off the engine jackets thus picks up a good many Btu that would otherwise be exhausted to the atmosphere and wasted.

The compressor and engine have a common cooling system, water flowing through the compressor jackets and then into the engine jackets (and on to the watercooled manifolds, after these were added). In normal use, as stationary or portable compressors, these units would be cooled by a fan and a heavy-duty industrial-type radiator. A built-in water pump on the engine circulates water through the jackets and into the radiator. When used indoors, radiators must be located so heat is dissipated outside the building or a fan or fans have to be added to expel the heated air.

On these jobs in our own plant, and as a recommendation where units are used for space or process heating, radiators and fans are eliminated. If only one unit is to operate, water is taken directly from discharge of the engine-compressor cooling system and circulated by the engine pump through the heating equipment. This may be unit heaters, hot-water radiators and convectors, or what-have-you.

Piping Hookup. Where there are several units, likely to be operated at the same time, best bet is to have them discharge into a header on the suction side of an independent circulating pump. As the diagram shows, this is what we did with our three units. The



HEAT-RECOVERY HOOKUP shows the water flow through aftercoolers, compressor jackets, engine jackets and manifolds, to pick up Btu for circulation to heaters

Unit Heaters for Savings

circulating pump discharges to the unit heaters. With this scheme, units can operate at variable speed if desired. The different pressure heads that would result on the engine pumps cause no circulation difficulties. Each unit discharges its hot water and it is pulled away by the independent circulating pump.

Aftercoolers. Part of the return water from the unit heaters bypasses through the aftercoolers and part goes directly to the intake header for the compressors. Enough water goes through the aftercoolers to cool the air properly—usually down to within about 10 F of water temperature. Note that this return water is coolest in the cycle. That's what we want for the aftercoolers.

Because of heat picked up in the aftercoolers, water entering the compressor jackets has a somewhat higher temperature. In the sequence through the two sets of jackets and the engine manifolds we match increasing water temperature with higher levels of heat disposal. This is necessary to give conditions desired in compressor and engine jackets, and to pick up as much heat as possible.

In hooking-up a number of units for heat recovery, be sure to valve the circuits at all strategic points. It will be necessary to cut units out for maintenance. Perhaps even more important, a properly valved hookup permits bringing the units into balance, especially where compressor and engine sets are of different sizes and designs.

Expansion Tank. Piping from the discharge header out to the heating system should, of course, be made in accordance with requirements for hot-water heating and plumbing systems. We found it highly desirable to install an expansion tank with a gage glass, and overflow connection. This goes at the highest point, and pipes from unit heaters pitch up toward it, before returning to the intake side of the system. In this way, the expansion tank gets rid of air that might be trapped in the system or leak out of the packing on the aftercoolers.

Controls. Certain controls are necessary and desirable. Often unit heaters are operated in groups with a thermostat for each group, or with individual thermostat. There should be a control in the hookup to keep unit-heater fans from operating until water reaches a preset minimum temperature. This prevents blowing cold air.

What about heat dissipation in the summer months? There are a variety of solutions, some simpler than others. In some cases, water can be circulated through the unit heaters just as in winter, but fans reversed (or heaters turned) to discharge outside the building. Where heaters aren't near windows, simple ducts can sometimes be rigged to carry the air outside.

Where such a scheme isn't practical, water must be circulated through a radiator, evaporative condenser, cooling tower or other device to dissipate the heat. Of course, if water supply is plentiful and cheap, raw water can be circulated through the engine-compressor cooling system and wasted to the sewer or back into a dispersal well.

Dollar Savings. The economics of heat recovery can't be generalized easily. The recovered heat replaces Btu for which additional fuel would have to be burned. This represents a direct saving. Against it must be charged the cost of equipment and piping necessary to recover heat and put it to work. In a case such as the one cited here, and in many others, these costs are relatively small and the scheme is productive of real dollar savings.

For engineers considering similar heat recovery on engine compressor units, here's a handy figure to remember—1250 Btu per hr per cfm of compressor capacity at 100 psi. That's what our experience shows for recovery from aftercoolers, compressor and engine jackets, and watercooled marine-type exhaust manifolds on the engines.

CORRECTION NOTICE

In the special section "Building Heating" (June POWER), it was stated that radiators and blast coils built of cast iron are limited to service at low pressures. While this is frequently the case, the cast-iron radiator shown in Fig. 2, p 80, and the sectional cast-iron blast coil of Fig. 12, p 81, built by D J Murray Manufacturing Co, are designed for use at steam pressures up to 250 psi.

Use of high-test cast iron and special design assure successful operation under these conditions.

SPEAKING OF POWER

One of the real peacetime dividends of atomic research is the growing use of radioactive tracers. Some idea of the many industrial applications of this atomic "tagging" can be gained from a bibliography on the subject recently released by Arthur D Little, Inc. Believed to be the most extensive yet prepared, this bibliography includes a brief introduction to the use of radioactive tracers and then lists some 175 references to books, pamphlets and articles. These are divided into three groups—general background references, survey articles of industrial applications, and papers dealing with applications in specific fields. Copies are available gratis from Arthur D Little, Inc, Cambridge 42, Mass.

★ ★ ★ ★

From London, Fred Brewster of McGraw-Hill World News reports that W H Allen Sons and Co, Ltd, of Bedford, and The Bristol Aeroplane Co, Ltd, are collaborating on application of gas turbines for marine auxiliary purposes and in the industrial field.

The Allen firm is well known as builders of industrial steam turbines, diesel engines, electric generating equipment, pumps, compressors and fans. Bristol has been a leader in developing aircraft gas turbines, notably the "Theseus" turboprop and the larger "Proteus" turboprop, which is scheduled to power a giant "Brabazon" 100-passenger civil transport, as well as 100-passenger flying boats.

★ ★ ★ ★

Giant blowers to provide the equivalent of a 700-mph speed, and atmospheric equipment to simulate altitudes to 65,000 ft and temperatures down to −67 F will be utilized in the Navy aeronautical turbine laboratory at Mercer Field, near Trenton, N. J. These facilities will subject jet engines to the most extreme conditions they may encounter in flight. De Laval Steam Turbine Co, which has been engaged on a secret turbine-engine project for the Navy, will supply altitude exhaust blowers for the testing equipment.

★ ★ ★ ★

Storage of natural gas to even out peak conditions is becoming commoner. Texas Gas Transmission Corp has embarked on a program of acquiring and developing underground storage facilities at seven sites. The sands of these fields will hold an estimated 21,500,000,000 cu ft.

Working on a different tack, Chicago District Pipeline Co proposes to build a $6,000,000 plant in Chicago for liquefaction, storage and regasification of natural gas. With a storage capacity of 400,000,000 cu ft, the plant will be capable of liquefying approximately 4,000,000 cu ft of gas daily and of regasifying and returning 6,000,000 cu ft per hr to the transmission system. The liquefaction process involves separation and recovery of butane and propane, removal of nitrogen, and storage of gas in liquid form at a temperature below the boiling point.

★ ★ ★ ★

Unable to match mounting consumption with new construction, and hampered by a protracted coal strike, Australian electric power authorities have ordered drastic cuts. In New South Wales, the most highly industrialized state, the cut amounts to 30%.

Herb Leopold, World Newser at Melbourne, tells us that squirrel-cage and slipring motors in many plants, condemned to idleness by the power cuts, are being pressed into use as induction generators in conjunction with available mains supply. Driven by old car engines or other suitable prime movers at a speed slightly above synchronism and excited from the mains, they feed back current at line voltage and frequency. The Sydney County Council, largest supply authority in New South Wales, has launched a campaign to promote use of these emergency generators and makes its engineers available for consultation.

★ ★ ★ ★

To supplement time-consuming chemical analysis of boiler scales and deposits, identification experts of Hall Laboratories now use the spectrograph in the solution of water-treatment problems. Ability to identify constituents of a deposit in a few hours, or even minutes, often makes it possible to ferret out causes of tube failures in jig time.

The sample is "burned" in a dc arc, where intense heat (5000 to 10,000 F) breaks down practically all compounds into their elements. Most of these are gases at such temperatures and give off definite, sharp wave lengths. These the spectrograph "sorts out," so they can be observed as a series of lines of different colors, or recorded on photographic film for further study. Characteristic lines for each element enable identification even when present in a mixture of many substances.

Lab men point out that the spectrograph does not replace but rather complements other techniques—chemical analysis, X-ray and microscope.

★ ★ ★ ★

We hear a lot these days about metals for high temperatures. Now along come the metallurgists of Lebanon Steel Foundry with a new alloy good for startlingly low temperatures, −423 F below zero, as a matter of fact. It is an austenitic cast ferrous alloy containing 19.5% chromium and 9% nickel, among other alloying constituents.

Tensile strength of this (L)−22 alloy varies inversely with temperature, going up to an estimated 200,000 psi at −423 F.

★ ★ ★ ★

Recent tests at the National Bureau of Standards indicate that several ceramics developed by the Bureau have superior strength and creep characteristics at 1800 F as compared with available high-temperature metal alloys. These materials grew out of a survey of nonmetallic compounds, especially the oxides, silicates, carbides and related combinations peculiar to ceramics. Technical Report 1373 describes the investigation and its results.

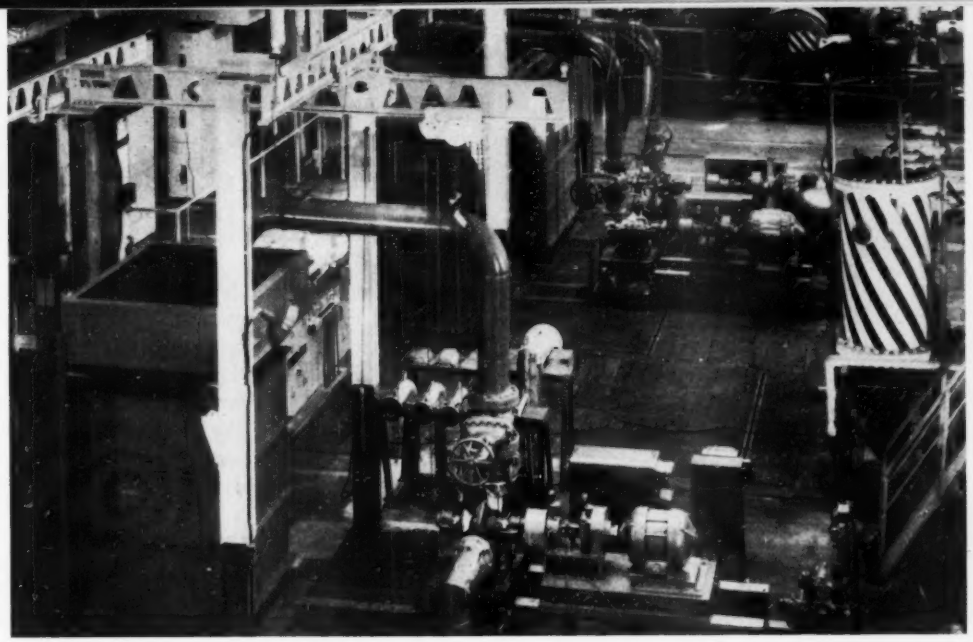
★ ★ ★ ★

A boiler drum 44 ft long and weighing 75 tons was lifted into place 10 stories above street level in the new $13,000,000 extension of the historic 59th Street power plant of the New York City Transit System. The B&W radiant boiler of which it is a part will have a steam-generating capacity equivalent to more than 30 of the old boilers in operation since the IRT Subway opened in 1904.

Because it is longer than the distance between columns of the boiler bay, the drum had to be lifted at a 45-deg angle and then leveled off at its 100 ft elevation. A few hours sufficed for the actual raising, but preparatory rigging took two weeks.

THIS MONTH'S COVER

Using a portable grinder, a worker smooths the vanes of a cast-steel francis-type waterwheel runner for the first of four additional 35,000-hp 92-ft-head hydraulic turbines now under construction in Allis-Chalmers shops for TVA's Wilson Dam power house. This runner will have a finished weight of about 95,000 lb. The four new turbines will bring the total number of units at Wilson Dam to 18.



ON TEST FLOOR there are three test stands similar in design but equipped to handle centrifugal pumps of different speeds and horsepowers. These were selected after a study indicated that most pumps within the range built could be tested on them

Centrifugal Pumps Tested Quickly and Accurately

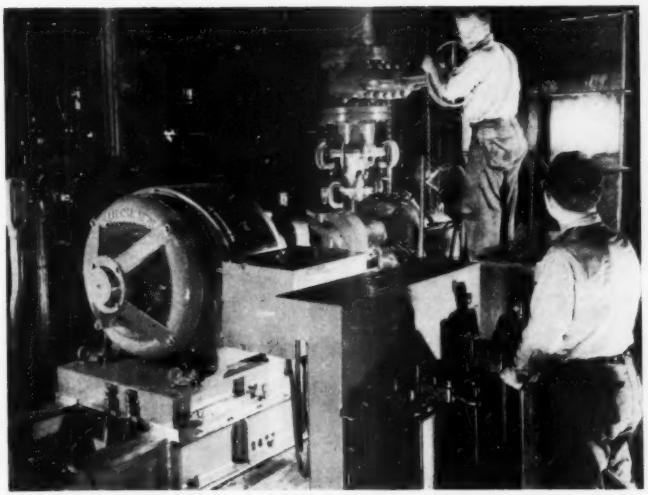
► How MASS TESTING of volume-produced industrial equipment can benefit from latest engineering developments is demonstrated on the new pump-test floor at Allis-Chalmers Mfg Co. Here highly efficient and accurate commercial pump-testing results from simplified mechanized setups, use of more accurate equipment and methods, and elimination of human error.

Electronic Devices. Water flow is measured by weight, utilizing a specially developed electronic timer. An ac electronic device measures motor speed to within one revolution per minute.

Human error has been reduced by having torque, speed, pressure and vacuum read on automatic recording instruments. Except for adjusting the discharge valve, an operator can control all phases of pump testing from a master control panel.

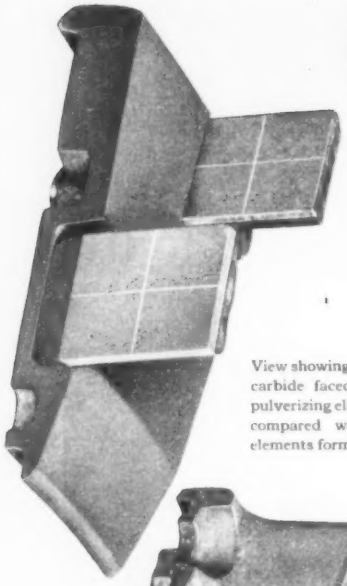
Designed to provide for maximum testing accuracy and minimum testing time and expense, the new facilities are of great importance to the com-

(Continued on page 106)

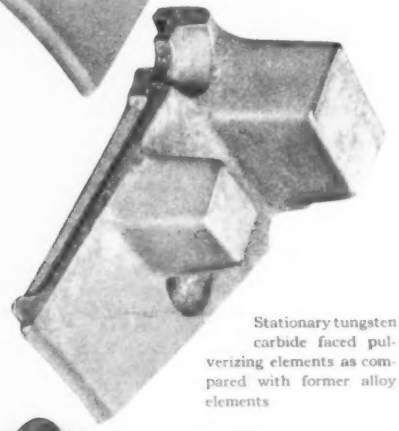


TO TEST PUMP one operator selects the motor speed by adjusting the controls while the other sets the valve to obtain correct discharge pressure for the test

Now RILEY Pulverizer



View showing tungsten carbide faced moving pulverizing elements as compared with alloy elements formerly used



Stationary tungsten carbide faced pulverizing elements as compared with former alloy elements

A great pulverizer development
Hardness near that of diamond

The use of tungsten carbide facings on Riley pulverizer parts adds tremendously to the life of the parts. Such parts when pulverizing sand to accelerate wear have outlasted six sets of alloy parts without showing any measurable signs of wear. Hardness of tungsten carbide approaches that of the diamond. Experiments and developments with the use of tungsten carbide pulverizer parts were started by Riley over ten years ago.

GREATLY REDUCED MAINTENANCE

While Riley pulverizers in actual use have been in operation with tungsten carbide parts for over two years, there is still no appreciable evidence of wear. These parts are good for many more years of service. Such long life results in greatly reduced maintenance costs placing the Riley pulverizer in a field by itself.

SUSTAINED FINENESS OF PULVERIZATION

Riley pulverizers equipped with tungsten carbide parts have shown no decrease in fineness of pulverization even after many times the amount of coal has been pulverized that formerly required replacement of parts. The fineness chart shows typical experience. As no wear is discernable to the carbide facings installed in these pulverizers, fineness will be maintained for many more thousands of tons of coal. No adjustments whatsoever are required to maintain fineness.

APPLICABLE TO EXISTING PULVERIZER

In keeping with Riley's policy of developing improvements which wherever possible can be applied to existing pulverizers, tungsten carbide parts can be installed in connection with most existing pulverizers. Many Riley pulverizer users have modernized their machines by applying this improvement. The following companies are a few of the many who have applied this improvement: Lynn Gas & Electric, Central Ohio Light & Power, Edison Electric Illuminating, Iowa-Illinois Gas & Electric, Potomac Electric Power, American Viscose, New York, New Haven & Hartford R.R., General Electric, Crocker-Burbank & Co.

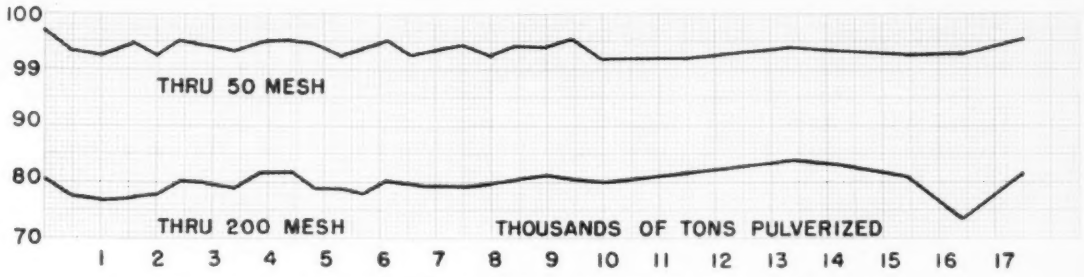
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Atlanta · New Orleans · Memphis · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

Parts with Tungsten Carbide Facings



Fineness against tons of coal pulverized. Fineness variations of any magnitude due to varying grindability.

Other operating advantages . . .

in addition to long life, low maintenance and sustained fineness of pulverization.

Flexibility—Wide Load Range

As change in coal feed gives instantaneous corresponding change in pulverized coal output—there is no lag—rapidly and widely fluctuating loads are efficiently and easily carried.

Ability to Carry Low Loads

With the combination of Riley pulverizers and burners, extremely low loads with stable ignition can be maintained. It is not unusual for load ranges of 10 to 1 or for loads under 5000 pounds of steam per hour to be carried at Riley installations.

High Primary Air Temperatures

There is no necessity of limiting primary air temperatures as a precaution against fire or explosion or because of lubricating problems. Expensive control equipment limiting primary air temperatures is not required.

Ability to Handle Wet Coals

With Riley pulverizers coal is pulverized in complete suspension, and not between two surfaces, affording the most effective drying effect from the hot air passing through the pulverizer.

Ease of Lighting

Because of small percentage of primary air, a rich and readily lighted mixture of air and coal is obtained which together with the uniform distribution with Riley burners makes lighting easy and gives stable flame at low loads.

Quiet, Vibrationless Operation

There is no comparison between Riley pulverizers and other makes insofar as quiet vibrationless operation is concerned. You hear nothing more than a motor hum.

Small Space Required—Minimum Foundations

Riley pulverizers require less space per unit of capacity. Massive deep foundations are not required due to their vibrationless quiet operation.

Explosion Proof

There has never been an explosion in a Riley pulverizer. The velocity of coal travel through the pulverizer is faster than the rate of flame propagation, eliminating the possibility of an explosion.

These Companies have installed Riley Pulverizer equipment

NORTHERN VIRGINIA POWER CO.
Riverton Station

IOWA ILLINOIS GAS & ELECTRIC CO.
Davenport, Iowa

CARNEGIE ILLINOIS STEEL CORP.
Carrie Furnaces, Rankin, Pa.

OTTER TAIL POWER CO.
Crookston, Minn.
Hoot Lake, Minn.

PENNSYLVANIA ELECTRIC CO.
Williamsburg, Pa.

CAROLINA POWER & LIGHT CO.
Moncure, N. C.

UTAH POWER & LIGHT CO.
Provo, Utah

EDISON ELECTRIC ILLUMINATING CO.
Boston, Mass.

MONSANTO CHEMICAL CO.
Everett, Mass.

WEST PENN POWER CO.
Milesburg, Pa.

SOUTHERN IND. GAS & ELECTRIC CO.
Evansville, Ind.

KENNECOTT COPPER CO.
Chase Brass & Copper Div.
Waterville, Conn.

RIEGEL TEXTILE CORP.
Ware Shoals, S. C.

BIRD & SONS
E. Walpole, Mass.

ARMSTRONG CORK CO.
Beaver Falls, Pa.

CALUMET & HECLA CONSOL. COPPER CO.
Calumet, Mich.

HOOKER ELECTRO CHEMICAL CO.
Niagara Falls, N. Y.

CONTAINER CORP. OF AMERICA
Manayunk, Philadelphia, Pa.

CELANESE CORP. OF AMERICA
Narrows, Va.

COLUMBIA RECORDS, INC.
Bridgeport, Conn.

CROCKER BURBANK & CO.
Fitchburg, Mass.

SAVANNAH SUGAR REFINERIES
Savannah, Ga.

C. H. MASLAND & SONS
Carlisle, Pa.

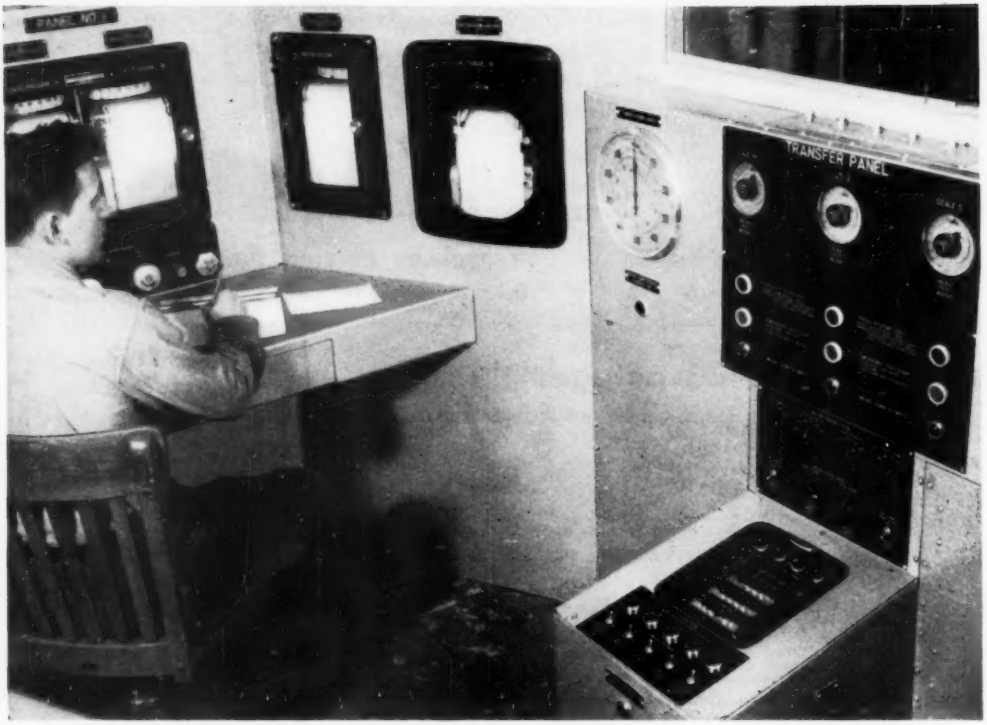
HORLICK'S CORPORATION
Milwaukee, Wis.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS



CONTROL-ROOM INTERIOR: In front of operator are 120-ft pressure, 30-ft vacuum, speed and torque recorders. On right are transfer panel, test-weight selector, pushbuttons, signals, and device that measures time to within 0.001 minute

pany's long-standing policy of obtaining and maintaining on file complete performance data on every pump it builds. Reduction in test time and labor by about 60% will aid in improving shipment time on pump orders, while more accurate data will be valuable to pump designers and users.

Test Stands. The new testing facilities have three permanent test stands, similar in design, but equipped to handle pumps with different horsepowers and speeds. These were selected after a study indicated that most of the units being built could be tested on them.

Each test station has a stand for mounting the pump, a discharge pipe suspended overhead, means for connecting meters and gages in the control room, and a hydraulic control panel, as on the left.

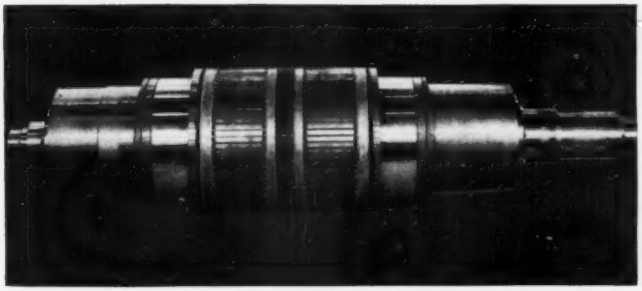
At each station the test stand consists of movable supports for the motor and pump. The pump test table is mounted on a hydraulic cylinder, and can be raised and lowered by a control lever on the hydraulic control panel. Large cylinder diameter gives rigidity. It can be clamped tightly in position by a hydraulically operated brake. The test table has T-slots to which the pumps can be bolted. This table can be moved sidewise or turned slightly in the horizontal plane by a handwheel and hand lever.

The motor, torque pickup, frequency-generator unit, and motor half of coupling to the pump are mounted as a unit on a sliding base. These can be moved toward or away from the pump by hydraulic power, controlled by another lever on the control panel.

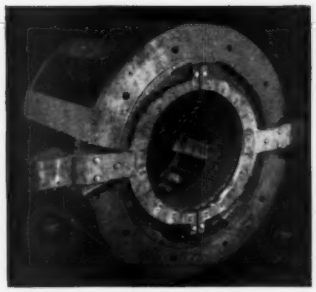
Connections to the speed and torque elements in the control room plug into the pickups from junction boxes on the side of a fixed base. Power connections to the motors on the test stands are permanent, except on the largest test stand. Large pumps may operate at any of several speeds, so provisions are made on this stand to exchange motors quickly.

Nerve center of the test floor is the control room, from which all operations in pump testing, except setting discharge pressure, are made. The room contains two control cubicles, separated by a transfer panel. Each cubicle has a recording speed meter, a recording torque meter, a recording 30-ft suction gage, and recording gages for 150-, 250- and 500-ft pressure.

The usual commercial test of a pump includes a series of short runs, each made at a different discharge pressure, during which a predetermined amount of water is pumped in an accurately measured period of time. During each run, pump suction and discharge pressure, torque input to pump, and pump speed are continuously measured and recorded automatically. Each run provides data from which a point can be plotted against discharge in gpm for each of three curves: pump horsepower, efficiency, and total head. Usually six to eight points are taken at pressures ranging from closed discharge to well beyond the rated conditions of the pump, often up to breakoff where pump will no longer lift water. An entire pump test, including recording data, calculations and plotting curves, seldom requires more than 20 min.



1 Armature conductors cut unidirectional magnetic flux passing from field poles through armature core. Watercooled brushes ride on collector rings at each end



2 Field poles generate a flux going in one direction through machine air gap

Is Homopolar Generator Now Practical?

Once again an attempt is made to produce a workable acyclic generator. Here are details covering new 21,000-amp unit built to feed dc to cyclotron

► GENERATION OF LARGE AMOUNTS of dc at low voltage, in a ripple-less stream, has been a constant problem with electrical engineers since Faraday's experiments in the early 1800's. One solution that goes back many years is the homopolar generator. This machine is essentially a 2-pole generator with the armature windings so arranged that they always cut lines of unidirectional magnetic flux. There is no need for a commutator. Dc is taken right off armature collector rings.

History. Scores of engineers have attempted to build such a generator, and at least six units have actually been produced. But the problems of poor voltage regulation, internal heat, short brush and bearing life were of such proportions as to make such a generator impractical.

Now, Electric Products Co in Cleveland, using designs and patents of James Caputo, Youngstown electrical engineer, has a homopolar motor generator that appears practical. At least it has proved to be all its builders and designer had hoped for. How it will fit into the picture alongside the time-tested selenium disk rectifier is a question. The trend has been away from dc generation. Rectifiers are being used instead to change the more flexible ac to dc.

Construction Details. The 30-ton machine, 13 ft, 8 in. high, is powered by a 600-hp motor on top. It produces 21,000 amp, 18.7 v at 1200 rpm. By lengthening the collector bars slightly it can deliver 100,000 amp.

Generator was built vertical because: (1) Such a design makes for better machine balance. (2) It's easy to get at all parts. (3) Unit conserves floor space.

To overcome difficulties experienced by others, Electric Products cools the 160 brushes with water. Water coming through the center shaft is also used to cool the armature. Cooling the brushes allows a higher-current density.

Magnetic flux moves from the field-pole face through the armature-pole face into the shaft. It passes through the shaft and into the end bell, then from the end bell to the stator frame and back to the field-pole face.

Entire rotating system is carried on two roller thrust bearings. One bearing is just below the motor mount on top of machine, while the other is under the magnetic disk at bottom. Field flux returning from the shaft to end bell is put to work. This flux is diverted through a rotating disk below the end bell, thereby setting up a magnetic lifting force to ease load on lower bearing when the machine is in operation.

To minimize possibility of bottom bearings becoming miniature generators themselves when machine is operating, bearing housing is made of a nonmagnetic material (an aluminum alloy) to keep field flux from straying into bearings.

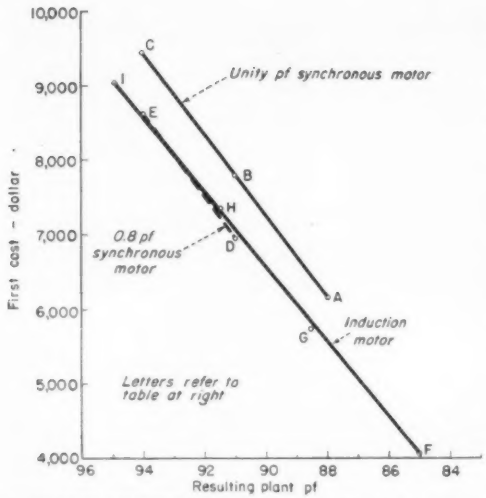
Application. Steel industry has been a fertile field for big current-producing generators with low voltage. One such horizontal generator of the homopolar type was built for an Ohio steel company in 1925-27. After two years of testing it was finally installed for use in welding operations. This machine was almost completely rebuilt before it could operate continuously, requiring new-type collector rings, different-type brushes coupled with jet air cooling.

For another steel company's plating departments, a horizontal homopolar motor generator was engineered to produce 40,000 amp. But it was tossed into the scrap heap when it chewed up brushes at the rate of a set every six weeks.

This present 21,000-amp 18.7-v job is getting ready to supply dc to the new synchro-cyclotron at Carnegie Institute of Technology. Other fields will beckon if this venture is successful.

Advantages. Using one of these generators will mean not only a large saving of floor space, but also economy in maintenance, first cost, and operation.

Now where 20,000 amp at about 25 v are needed, construction of a large generator set is called for. Some manufacturers of electrical equipment fix the largest practical mg set as one producing 10,000 amp at 25 v. Where larger amounts of current were required, units of that size were built and harnessed together. Plans are already on the drawing boards for a homopolar generator with a capacity of one million amp at 50 v.



FIRST-COST ANALYSIS of synchronous and induction motors along with capacitors. Operating costs are not considered here

BREAKDOWN OF MOTOR AND CAPACITOR COST

Equipment used	Resultant pf	Cost of motors, controls	Cost of capacitors	Total investment	Yearly penalty
A: Unity pf syn motor	.88	$6150	....	$6150	$787
B: Unity pf syn motor plus 120 kva	.91	6150	$1650	7800	449
C: Unity pf syn motor plus 240 kva	.94	6150	3300	9450	112
D: 0.8 pf syn motor	.91	6960	....	6960	449
E: 0.8 pf syn motor plus 120 kva	.94	6960	1650	8610	112
F: Induction motor	.85	4080	....	4080	1125
G: Induction motor plus 120 kva	.885	4080	1650	5730	730
H: Induction motor plus 240 kva	.915	4080	3300	7380	395
I: Induction motor plus 360 kva	.948	4080	4950	9030	22

Note: Kva rating refers to capacitor size

Figuring Costs for Better Power Factor

BY SERGIO MARTINEZ JR*
Frederick Snare Corp, Caracas, Venezuela

► OUR LITTLE TEXTILE MILL has a load of about 1386 kva at 0.85 pf. This works out to 1178 kw, consisting mainly of small induction motors. On top of this load we planned to add a 200-hp motor to drive a compressor. The latter was part of the air-conditioning equipment.

Pf Clause. We planned buying all power from the local utility company. They had a pf adjustment clause that would penalize us if the pf dropped below 0.95. The penalty was to be calculated according to the formula:

Penalty charge = (95–pf) × kw average demand × $0.007

To find the most economical way to power this compressor we ran down the following quotations:

1. Unity pf synchronous motor with control.....$6150
2. 0.8 pf synchronous motor with control..... 6960
3. Induction motor and control..... 4080
4. Static capacitors with control (120 kva)..... 1650

We worked out nine possible practical combinations using the three types of motors in combination with capacitor banks. We then went on and calculated expected pf as well as yearly penalty.

After looking over the above table it was easy to eliminate *B* and *C*. They had the same penalty as *D* and *E* but represented a larger investment. The unity pf synchronous motor *A* was then eliminated by comparing with *G*. The latter involved a lower investment, in addition to a smaller penalty. At this stage only the 0.8-pf synchronous motor and induction motor were in the running.

Remaining Solutions. By simple inspection it is readily seen that *E* or *I* were the ones to use. To tackle this job in a straight academic fashion would mean including the initial investment, interest, depreciations and a comparison of annual operating costs. In this light our homespun practical approach falls short. Now that we look back over the job we can readily see how, on close comparison, operating costs and machine efficiencies would play a big part in selection.

But in this particular case we made our decision simply on the basis of inspection. And that led us to choose between the 0.8-pf synchronous and induction motor, both coupled with capacitors. The 0.8-pf synchronous motor and 120-kva bank of static condensers represented an investment of $8610. Along with this went a yearly penalty of $112. Now the induction motor and 360-kva capacitor bank meant a $9030 cash outlay and a yearly penalty of $22.

We deliberated some time before coming to a decision on the last two. We finally settled for the induction motor and 360-kva capacitor bank. Our conclusion was based partly on the annual $90 saving for a $520 additional investment. We say "partly" since the question of operation and maintenance did come into the picture. From our experience we found induction-motor operation was simpler and required less maintenance than the synchronous motor.

Additional Factors. Although we used the above solution, we fully realize the many factors (some of them quite important) that enter the picture. First is the short period that we considered in analyzing costs. A rigorous treatment would consider the total cost from the date of purchase to the end of normal machine life expectancy.

In this complete analysis, the annual costs, penalty and salvage value would be considered for the full period.

It is granted that our case was far from ordinary. Generally speaking, it is not profitable to improve pf of industrial loads beyond 85%. The reason is that the amount of corrective equipment for improvement beyond 85% usually increases much faster than the worth of the benefits achieved.

Much has been written on how pf improvement cuts power loss in feeders, releases additional capacity of both feeders and distribution equipment, and ups load voltage. Each of these factors does come into the picture but can be overlooked where pf change is small.

Another item to consider is the matter of overmotoring. This alone can be a major factor in pulling the plant power factor down. Motors can often be juggled in an existing plant to keep each loaded up near its full load rating.

* The author was formerly with the Ariguanabo Textile Co in Bauta, Cuba. He was with that concern when he prepared this article.

'There's a Tube Let-Go in Number . . .'

What do you do when you hear that call? Engineers still get into arguments about it, but steps to take that hold damage to a minimum are pretty well settled. Let old-timer J M Gorrie tell you what happened in one plant and how they got the boiler back on the line on the next shift

►ONE DAY WE WERE SITTING in the Chief's office blathering and blarneying about how good we were. Patting each other on the back. Complimenting ourselves on our marvelous accomplishments around the old plant during the summer just past.

We had cleaned the hot-process lime-soda setup and the filter tanks. The chemical tank had been scraped and the agitator bearings renewed. Pumps had been cleaned and repaired. The boiler-feed pumps had been taken adrift, new bearings installed and a new impeller fitted in one unit. The insurance inspector had given the boilers a clean bill of health.

Plant Setup. The plant we were bragging about could be described as an "above-average" industrial power plant. It contained four 7500-sq-ft watertube boilers. These were known as the "small" boilers. The other two, in our language, were "large"—one good for 135,000 lb per hr and the other, a Stirling, being good for 100,000 lb per hr at peak. Both had waterwalls and economizers of the "outside" type—not in the settings. Turbines drove the induced-draft fans and motors the forced-draft. All boilers were stoker fired. The "small" boilers had individual combustion controls, as did the "large" ones.

There was only one thing that dampened our enthusiasm. That was the coming winter when coal would be frozen solid in the cars. So we griped about it, not having much else to do.

The air in the office was thick with the reek of well-worn briars that had smoked everything from P.A. to mixtures of whatever could be smooched from the gang's pouches. Even the talk had a flavor of Colin Glencannon.

The Scene. You can visualize the scene. Windows that couldn't be seen through. An enormous brass spittoon. Desks covered with stuff from this'n that to old and dog-eared catalogs. One wall plastered with pictures of the gang, calendar art and the inevitable licenses. Three of us sprawling back in chairs, feet on whatever was handy.

Well, there we were, all trying to say something exceedingly remarkable at the same time, when the door banged open and a voice shouted,

"There's a tube let-go in Number . . .!"

The party with the voice disappeared as suddenly as he'd come. We looked at each other calmly. There was no consternation. We got up nice and quiet, then dashed like scared cats for that door, tripping over each other's feet to get out and start that reserve feed pump. One of us threw the switch, starting the pump. Past experience had tipped us to its value.

Up we went to the boiler to see what cooked. Finally we came to an inspection door that gave us a fair view of the tube rupture. Water from the tube had quenched the fire on the surface only. Now and again a lurid glare would sweep over the furnace from the "watery" side. The other side of the fire burned along merrily.

We stopped the forced-draft fan, put the stoker on high speed, brought into play the old standby fire hose and

commenced playing a fine spray on the rest of the fire. We kept the induced-draft fan running, but at reduced speed.

Quick Action. Time is a remarkable thing for measuring speeds, flows and other things, but it telescopes when events come thick and fast. Strange to say, all these steps, which take so long to tell, were completed in a matter of minutes. This even included opening the emergency feed valve direct to the boiler. The main feed went from the economizer through the feedwater regulator.

Water from the ruptured tube and the fire hose was cascading through the tuyeres down into the ash drop, into the "fines" hoppers under the stoker, and from there to the basement floor. It surged from the ashpit hopper doors and bypasses on the hoppers. Water? Sure there was water, but it settled

Water? Sure there was water . . .

into the sump pit where the sump pumps, two electrics and a steam ejector, took care of it and pumped it into the sewer connection.

Temperatures Drop. Temperature of the feedwater had dropped from an average of 295 to 212 F, which is the average temperature at the pump after water passes through the filters.

We watched the stack temperature drop. This boiler, like the other large one, had its own stack. The four small boilers had one stack for all. At peak loads, average stack temperature was around 600 F, while temperature of last pass to the economizer averaged around 800 F.

Remember that when the forced-draft fan was stopped, we opened all inspection doors and also the ashpit doors. Bear in mind also that we kept the induced-draft fan running at reduced speed. Feedwater was entering the boiler at 212 F.

Feed Stopped. When we saw last-pass temperature drop to 300 F, we stopped feeding the boiler, shut off the emergency feed pump and started to drain the boiler by opening all side-waterwall-header blowoffs and main-drum blow-off. Steam pressure was roughly 5 psi.

The tube ruptured at about 9:45 a.m. At 11:10 we drained the boiler.

Here's where we stood, one hour and twenty-five minutes after the blow. The stoker was pushing the dead fire off the retorts into the ashpit, where it was finally hosed and drawn through the pit doors. The only water left in the basement was in the trenches of the ash-gun piping.

Tackling the Drums. At 12:00 noon, we opened the upper drum and surged cold water into it to further cool down the boiler. This was done with the fire hose.

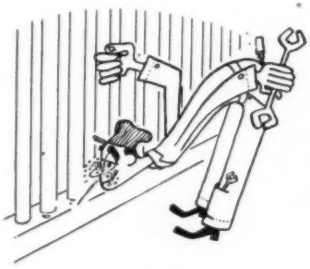
At 12:30 pm, we opened the lower drum by removing the manhole plates, and again the firehose and an air hose were brought into play for cooling. Then we began to remove the rear-waterwall-header handhole plates so work could begin on removing the offending tube, which was in the rear waterwall.

By 1:15, we had the tube out. Then we inspected for possible damage to tuyeres and other parts of the stoker. At 1:30, the furnace was cleaned of all ashes and work started on putting in the new tube. By 2:00, we were expanding the tube. At the same time, the stoker went back into operation, feeding coal in preparation for a fire.

When 3.45 rolled around, we had the manhole plates back on the drum heads. At 4:00, the final handhole plate of the rear waterwall header was tightened. The crucial test began.

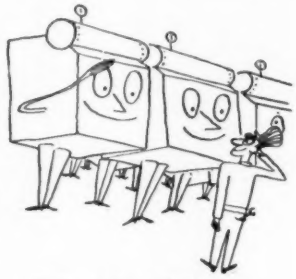
Crucial Test. First we had to see if the handhole plates were tight, because this particular boiler had the doggonedest handhole plates ever designed. They would hold water until it was almost to the gage column, then the blasted things let go. We started filling the boiler. About this time we managed to get the ash gun in operation.

There was the usual squinting around the headers to see a possible tiny squirt from any of the handhole plates that had been removed. None showed, but we kept up the watch for possible leakage at handhole and manhole plates. At 5:20 pm, we had the boiler water at



To see a tiny squirt . . .

operating level. At 6:00 we started the hydrostatic test to spot any leakage around the newly fitted tube. No leakage showed at 200 psi so we stopped the test. The torch was applied to the kindling, rags were dumped on top of the coal, and the fire was lit off. At midnight the boiler was back on the line.



Boiler back on the line . . .

Nothing dramatic. Nothing remarkable. This was the second time we had experienced a tube failure on this boiler. The first was a series of cracks on a rear-waterwall tube. The boiler water did not surge out as in the case described here. Each time, however, we started the second motor-driven boiler feed pump and doused the fire with a fine spray from the fire hose.

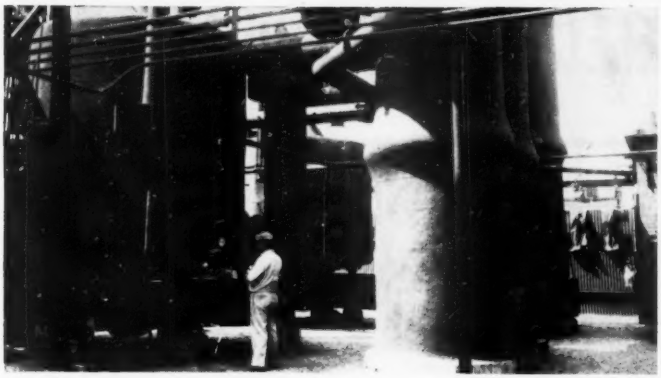
This brings up the old argument of stresses and strains, also the argument

Hell and brimstone theories . . .

about cooling the boiler drums and "flooding" the furnace with water. These might be termed the "Hell and brimstone theories," propounded by the "don't do thatters."

Remember that at about 200 psi, temperature in the drum is less than 400 F. The trick is to pull this down, not let it be raised to dangerous levels by the stored heat in the furnace setting. That's the reason for killing the fire, keeping the induced-draft fan running and feeding as much water as possible. It's when that stored heat goes to work on tubes short of water, or actually dry, that real damage develops. That's what the cooling-down method avoids.

How to Insulate Your Heat Exchanger



► ALTHOUGH HEAT EXCHANGERS are used primarily to increase plant efficiency, the exchanger itself is often operated inefficiently because it isn't properly insulated.

The amount of wasted coal per sq ft per year is extremely high when high-temperature equipment is uninsulated. The table below (from *Engineering Bulletin No. 2*, U. S. Fuel Administration) shows this clearly. A careful insulation job, as in the diagram below, can save over 90% of the heat ordinarily marked off for waste. Here are reliable instructions:

How to. Exchanger surface should be cleaned of dirt, grease and other extraneous material. Then follow the steps in the diagram.

Apply mineral-wool blankets directly over the surface. Acme galvanized bands, or strong wires on 6-in. centers, secure the blankets. For a smooth, uninterrupted exterior, trowel a half-inch layer of insulating cement over the surface and joints of the blankets.

When the cement is thoroughly dry, stretch one-inch-mesh galvanized-wire netting tightly over the surface, and secure it permanently. This provides ample reinforcing for a ¼-in. coat of asphaltic weatherproofing applied over the netting, if the job is outdoors.

Large Savings. A good insulating job will save much coal. The following hypothetical example gives a fair idea of typical savings:

1. Equipment to be insulated:
   Heat exchanger 7-ft diameter x 22-ft length
   Operating temperature 212 F
   Average room temperature 70 F
2. Suggested insulation:
   One-inch mineral-wool blanket
   ½-in. mineral-wool insulating cement
   ¼-in. weatherproofing
3. Heat-loss analysis:
   Area of exchanger, 561 sq ft
   Heat loss from bare surfaces, about 334 Btu/sq ft/hr
   Heat loss after insulation, about 30 Btu/sq ft/hr
   Heat saved, about 304 Btu/sq ft/hr
4. Fuel savings
   304 Btu/sq ft/hr x 561 sq ft = 170,000 Btu/hr saved

170,000 Btu/hr x 24-hr day x 300-day yr
13,000 Btu/lb coal x 2000 lb/ton x 70% eff
= 67 tons of coal saved per year.

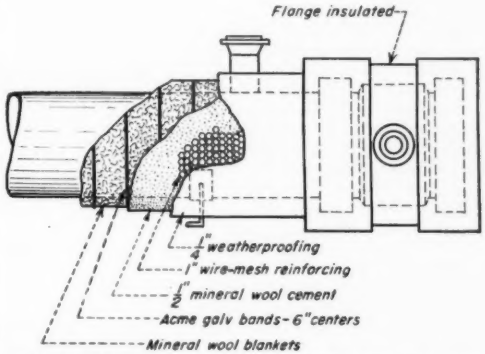
"Control of Industrial Heat and Power Losses," a bulletin of the Industrial Mineral Wool Institute, 441 Lexington Ave, New York City, gives other examples of savings by heat insulation.

In general it can be said that each square foot of steam-heated bare surface will waste from 300 lb to 1000 lb of coal per year. Proper insulation will cut this loss about 90%.

TABLE TO SHOW COAL WASTE

Temperature of surrounding air is 70 F

Gage pressure	*Steam temp, F*	*Temp diff: steam and surrounding air, F*	*Loss per hour per sq ft, Btu*	*Coal waste, lb per sq ft per yr*	*No. of sq ft of surface wasting 1 ton coal a yr*
0	212	142	334	293	6.82
10	240	170	425	372	5.38
25	267	197	522.5	458	4.37
50	298	228	644	564	3.55
75	320	250	737.5	646	3.10
100	338	268	820	718	2.79
150	366	296	960	840	2.38
200	388	318	1079	945	2.12
250	406	336	1184	1036	1.93



HEAT EXCHANGER, mineral wool insulated, can save over 90% of waste heat. Proper steps are shown in cutaway above

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

18—Capacitors Delay Ac Relay Operation

► IN THE PRECEDING ARTICLE we studied dc time-delay relays and compared their operation with an ac design. Here we will study the operation of the latter.

Grid Rectification. Fig. 1 and 2 are similar to Fig. 7 and 8 in July POWER, p 120, except the connections are arranged so the relay is open when switch D is open, and closed when D is closed. When the transformer has the polarity in Fig. 1, capacitor C_1 is charged by grid rectification to the polarity shown.

This circuit is from S_3 to the cathode and the grid, the latter acting as an anode, capacitor C_1, R_1 to S_2. When the capacitor is charged current also flows through R and R_1 to S_2. On reverse transformer polarity, capacitor C_1 discharges through resistor R. It is also in series with transformers S_2S_3 to keep the grid bias minus.

The minus bias potential is from S_2, which now is minus, through R_1, the capacitor to the grid, the cathode back to S_3, and + on the transformer. This gives the grid a minus bias equal to the instantaneous potential of the transformer plus that of the capacitor to prevent the tube conducting and closing the relay.

Grid Bias. Closing D as in Fig. 2 shunts out the grid circuit from the transformer so the capacitor is not charged by grid rectification. The transformer has a circuit from S_2 through R_1, switch D to S_3. The capacitor is free to discharge through R as indicated. It also tends to discharge from grid to cathode and through the transformer circuit to maintain the grid minus.

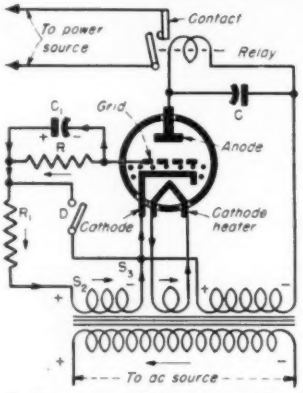
The longer the capacitor discharges through R, the lower its voltage becomes, resulting in a decreasing grid bias. When this bias is low enough the tube passes enough current to close the relay as shown. The time delay, from when D closes to when the relay pulls in, depends on the ohmic resistance of R and the rating of the capacitor, as explained in the preceding article. In this circuit arrangement resistor R_1 is necessary to cut the grid away from transformer S_2S_3 when switch D is closed.

Adjusted Time Delay. Fig. 3 diagrams a general-purpose time-delay relay that includes a potentiometer P to adjust the time delay. The relay includes an autotransformer for operation on either 115 or 230 v. On a 230-v line, the autotransformer operates as a 2-winding unit supplying low-voltage current to heat the cathode only.

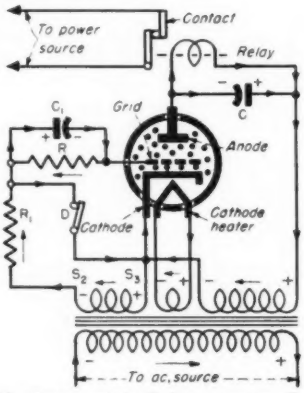
When 115-v power only is available connections are made from the center tap to an outside leg. Then the unit operates as an autotransformer to step line voltage up to 230 and as a 2-winding step-down transformer to supply cathode-heating current.

As in Fig. 1 and 2, relay closes when switch D closes and opens when D

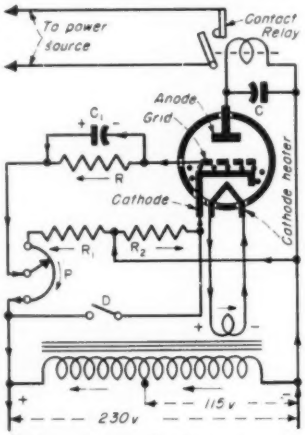
Ac Time-Delay Circuit



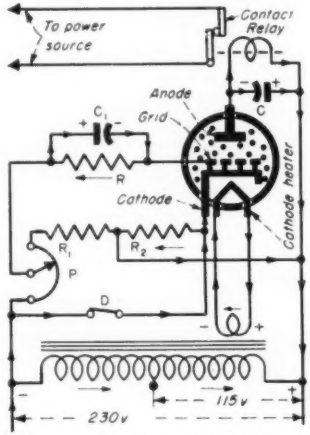
1 When switch D is open grid has a minus bias and tube cannot conduct



2 Closing switch D lets capacitor C_1 discharge to remove bias from grid

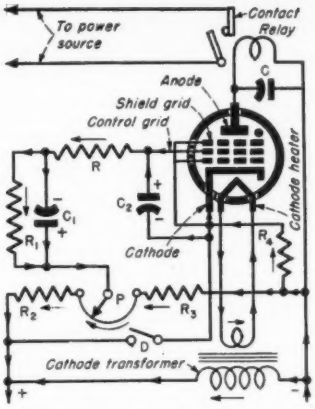


3 Potentiometer P adjusts time delay in relay closing after switch D closes

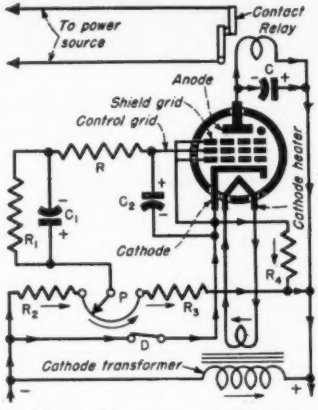


4 Same as Fig. 3 but switch D is closed to actuate relay after a time delay

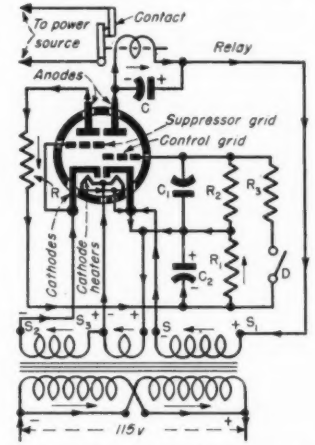
Thyratrons and Duel-Element Tubes



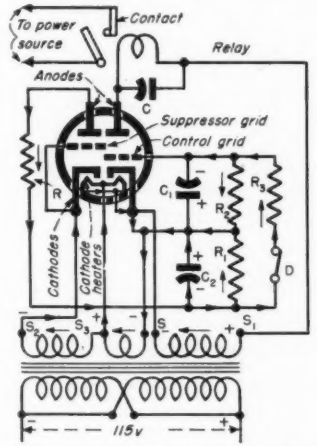
5 A thyratron replaces the vacuum tube in this time-delay relay circuit



6 When switch *D* closes, grid loses control of tube and the relay closes



7 Time delay in this relay prevents too rapid relay operation if *D* bounces



8 When *D* closes, relay opens quickly because of the charge in capacitor C

opens. Assume 230-v operation and line polarity as shown. Capacitor C_1 is charged by grid rectification. This circuit is from − line, through R_2, the cathode, grid, capacitor C_1, potentiometer P, and to the + terminal.

Capacitor Charge. There is also a circuit through R_1 and P. Voltage drop across the lower part of P opposes that applied to the grid to charge the capacitor, and this determines the time delay. If the potentiometer's arm is turned to its lowest position all of P resistance is cut out of circuit. Then capacitor C_1 is charged to nearly line voltage, because volts' drop across R_2 and the tube is low.

R_2 has a resistance of about 10,000 ohms only, where R in parallel with the capacitor has 3 megohms. As the capacitor becomes charged and the rate of current flow decreases, volts' drop across R_2 and the tube also decreases. So the voltage across C_1 increases, until its full charge practically equals line volts. Current through R is so small it has practically no effect in the circuit.

Since the capacitor is charged to nearly line volts, time-delay will be a maximum, which in this relay can be from about 1 sec to 2.5 min, depending on its design.

Time-Delay Control. If the potentiometer's arm is moved to its uppermost position, then all of resistance P is in series with the capacitor. Since R_1 and P have about equal resistance, about one half of line volts or 115 v is across R_1. Since P is in series in the grid rectification circuit the capacitor will be charged to about 230-115=115 v only. Consequently, time delay for the relay closing will be at a minimum and may be from 0.05 to 8 sec, depending on the relay selected.

Any time delay between the minimum and maximum can be obtained by positioning the potentiometer. For example, if the minimum delay is 0.6 sec, and the maximum 12 sec, then any time delay between these two values may be had with a high degree of accuracy, except as affected by variations in line volts. A 5% increase in line volts decreases the timing interval by almost 3%, whereas a 5% decrease in line volts increases the timing interval about an equal amount.

Relay Closes. When line polarity reverses, Fig. 3, the capacitor discharges slowly through resistor R. The capacitor is also in series with line volts to drive the grid minus, and block the tube from conducting and closing the relay. This voltage acts through a circuit from the left-hand line, through P, C_1 to the grid and cathode, R_2, to the right-hand line.

There is also a circuit from the left-hand line through P and R_1 to the right-hand line. This produces a voltage drop across P, part of which opposes the grid bias. So the minus bias on the grid at any instant equals line volts, plus capacitor volts at that instant, minus the drop across the part of P in the circuit. This bias is always enough to keep the tube from closing the relay.

Fig. 4 is the same as Fig. 3 but with switch D closed on reverse line polarity. With switch D closed capacitor C_1 cannot be charged by grid rectification, because when the right-hand line is minus the circuit through R_2 goes directly through D to the left-hand line. This shunts out the grid.

Capacitor C_1 discharges through R and also tends to discharge from grid to cathode to the left-hand line, back to + on C_1, to maintain the grid minus. When the capacitor's charge has decreased a predetermined amount, grid bias falls to where the tube passes enough current to close the relay. Arrow heads indicate the relay-coil circuit. On opening switch D, conditions return to those in Fig. 3 and the relay drops out.

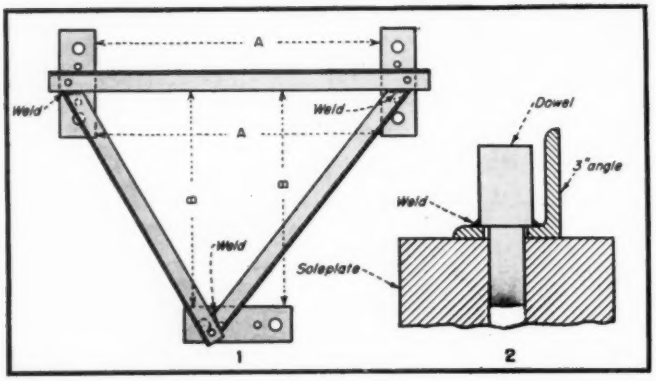
Thyratron Amplifier. Fig. 5 diagrams a time-delay relay that uses a thyratron as the amplifier. A thyratron is a grid-controlled gas-filled tube. Current flow through these tubes does not gradually increase as the minus bias on the grid decreases as in a vacuum tube.

(Continued on page 148)

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

USES JIG TO AVOID RENEWING FOUNDATION SOLE PLATES



THE FOUNDATION SOLE PLATES under a 5000-kw-turbine gear set were loose. Upon taking the gear case off these plates, we found the grouting broken up and partly pulverized. We had to remove the plates to clean out old grouting and realign steel shims under all three of them. Size of the sole plates and design of the gear case supports made it necessary to use the same dowel holes or make new plates.

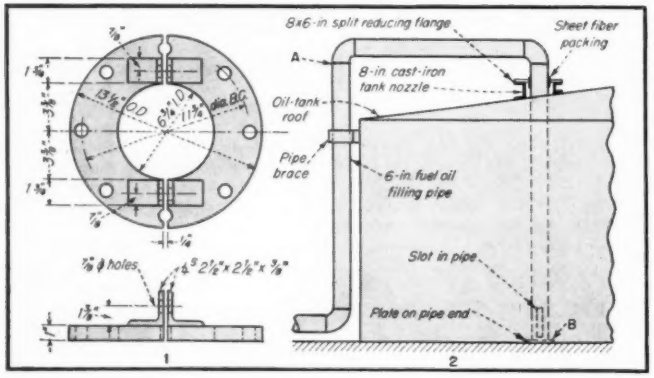
A jig was made of 3-in. angles, Fig. 1. Angles were laid out on top of the original sole plates before moving them. The angles were then welded together and holes laid off on them to correspond to the three dowel holes in the sole plates. As it was practically impossible to lay out the holes in the angles exactly, they were drilled larger to allow for slight errors.

Three dowels were then machined to just fit the holes in the sole plates, with a larger diameter on top of the dowel to cover the larger holes in the angles, Fig. 2. The jig was placed over the sole plates and the dowels inserted through the angles into the plates. They were then welded to the jig. Measurements were taken at *A* and *B* to set the plates back in their same relative positions upon finishing the job.

One sole plate was removed and repaired at a time. This way we had two points to start with at all times. On completing the job, we set the gear case back in its original position.

F J HERZINS *Tyrone, Pa.*

HOW TO INSTALL NEW FILL LINES IN FULL OIL TANKS



WE HAD TO INSTALL an added 6-in. filling pipe in each of two fuel-oil storage tanks that were in service and full. To prevent forming oil mist, filling should be at the tank bottom. This ruled out flame cutting and welding.

Each tank had two spare 8-in. cast-iron tank nozzles with standard 125-lb flanges in its roof. One of these was used in each tank. A run of pipe from *A* to *B*, Fig. 2, was made up for each and lowered into place. This was a simple pipe welding job without any complications.

It was necessary to seal the pipe, where it passed through the tank nozzle, against the entrance of rain water and also to support the pipe in place. It was desired that tank breathing take place through the regular tank vent, which had an underwriters-approved hood.

This was done by the split 6x13½-in. reducing flange, Fig. 1. It was drilled out 6¾ in. (⅛-in. oversize) for the 6-in. pipe. The pipe was wrapped with sheet packing. A gasket was placed between the flanges and bolted together. The two halves of the split flange were drawn tight around the pipe by means of ¾-in. bolts through the angle lugs.

H T LIVINGSTON *Los Angeles, Calif.*

(*Continued on page* 116)

NEW Edward INSTRUMENT VALVES

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HERE'S A NEW DESIGN in instrument valves — forged steel for strength in high temperature or high pressure service; no bonnet joint, swing bolted gland for easy packing adjustment.

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Built in globe or angle design, screwed or socket welding ends, ¼ in., ⅜ in., and ½ in. sizes. Working pressure ratings 6000 lb WOG, 1500 lb at 850 F with carbon steel bodies, and 1500 lb at 1000 F with 13 per cent chromium EValloy stainless steel bodies. Write today for Bulletin 491.

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SLIDE RULE PINCH HITS FOR DUCT CHARTS

EVERY TIME A CONTRACTOR needs to have a duct size changed because of interferences you don't have a chance to go back to the office to consult the charts. A slip-stick, though, pinch hits very easily for a duct-sizing chart.

Whenever duct dimensions have to be changed, care must be taken to keep the friction loss the same. For example, a 36x36-in. fan-discharge duct is too big. Depth must be changed to only 18 in. What's the new width for the same friction loss?

Fig. 1 shows the original round diameter used in finding the 36x36 in., $a \times b$, duct. New duct will be x by y. The known dimension is y, x must be found, for equal friction loss. It's difficult to remember the complete formula given at the end, but it's easier to recall

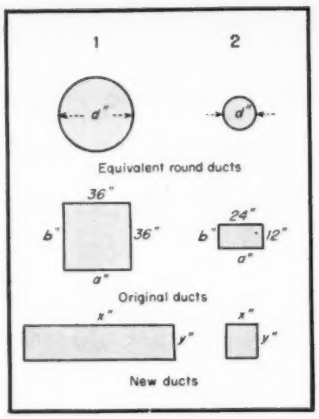
$$xy = \sqrt{\frac{x+y}{a+b}}$$

To start, find the original area,
$36 \times 36 = 1296$ sq in.
An approximation of the new width will be $1296/18 = 72$ in. Substitute in the formula above

$$\sqrt[3]{\frac{72+18}{36+36}} = 1.077$$

Then $1.077 \times 1296 = 1397$ sq in., say, 1400 sq in. which is the first approximation of the new duct area. With this area the new width is $1400/18 = 78$ in. Substituting the new value in the formula.

$$\sqrt[3]{\frac{78+18}{36+36}} = 1.105$$



Then $1.105 \times 1296 = 1430$ sq in. Finding the new width $1430/18 = 79.4$ in. Continuing with the approximations,

$$\sqrt[3]{\frac{79.4+18}{36+36}} = 1.106$$

$1.106 \times 1296 = 1433$ sq in.
$1433/18 = 79.7$ in.

Difference between 1430 and 1433 sq in. is so small that 80 in. may be considered the practical width. Later, checking it against a duct chart it's found to be exact. With a little experience it's possible to up the first approximation of the new width immediately, and hit the dimension exactly.

As a second example, a 24×12-in. duct must be changed to 16-in. width. What's the new depth for the same friction loss?

$24 \times 12 = 288$ sq in.
$288/16 = 18$ in.

This looks reasonable because the new duct will probably be nearly square, Fig. 2. Then,

$$\sqrt[3]{\frac{16+18}{24+12}} = 0.981$$

$0.981 \times 288 = 282$ sq in.
$282/16 = 17.6$ in.

This value of 17.6 is so close to 18 in. that it can be accepted as correct. A duct chart shows it should be a little over 17 in.

Derivation. The ASHVE formula for equivalent diameter is,

$$d = 1.265\sqrt[5]{\frac{(ab)^3}{a+b}}$$

For another duct x by y, with the same friction loss

$$d = 1.265\sqrt[5]{\frac{(xy)^3}{x+y}}$$

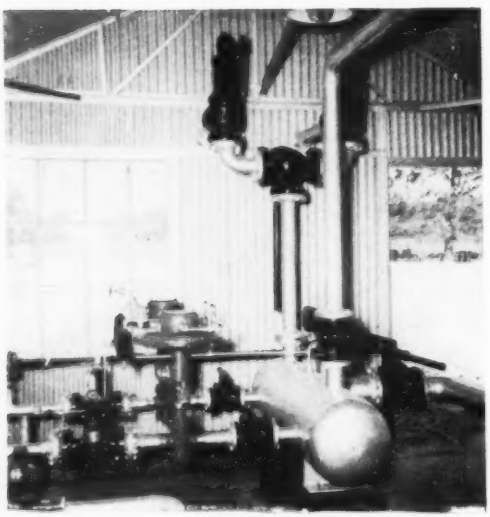
$$\text{Equating } \frac{(xy)^3}{x+y} = \frac{(ab)^3}{a+b}$$

$$\text{Then } xy = ab\sqrt[3]{\frac{x+y}{a+b}}$$

This is the formula used in the approximations above.

TYLER G HICKS *New York, N. Y.*

FUEL SYSTEM MANIFOLD ACTS AS SEPARATOR



DUAL REGULATORS ensure unbroken flow of fuel gas if one is down for adjustment. In one plant they tie into a short horizontal receiver, which is fabricated from 14-in. pipe with formed ends. The two lines from the regulators enter along one side of the receiver, with the 4-in. line carrying fuel to the plant boilers set opposite to the two inlets and midway between them.

Fuel for the gas engines in the plant is taken off through a 3-in. riser set into the top of the receiver. This ensures maximum dryness of the natural gas. A riser at the opposite end of the receiver carries the dual relief valves exhausting to atmosphere.

The receiver set just behind the dual regulators allows the gas stream to slow down and helps to deposit any moisture that may have condensed by the pressure drop across the regulators.

Change in direction and long vertical section of the gas line to the engines also aids in removing entrained droplets.

A drain line set in the base of the receiver ties into a trap that automatically vents liquids as they collect. This whole setup has shown the results of careful planning and engineering. The layout is compactly and symmetrically arranged but at the same time all elements are accessible for easy maintenance.

ELTON STERRETT *Houston, Texas*

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Because they eliminate the commonest source of trouble and expense in ordinary blow-off valve service, Yarway *Seatless* Blow-Off Valves mean real economy to boiler plant operators. *Yarways have no seat to score, wear, clog and leak.* Lubrication is usually the only maintenance they require.

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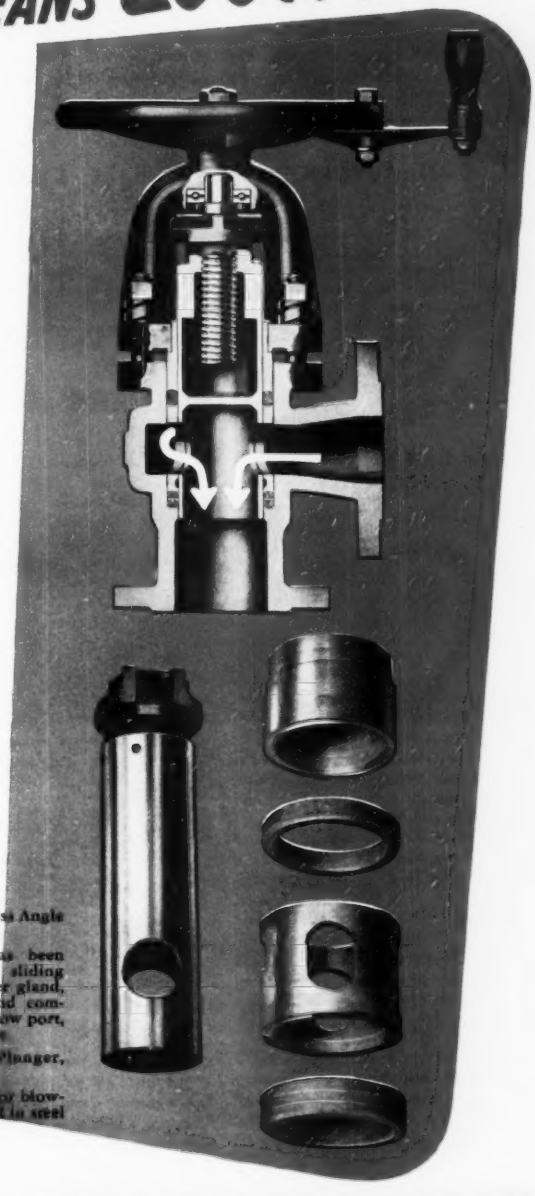


(*Above*)—Cross section of Seatless Angle Valve, flanged.

OPERATION: After valve has been closed, shoulder on balanced sliding plunger contacts upper follower gland, forcing it down into body and compressing packing above and below port, making an absolutely tight valve.

(*Below*)—Balanced Sliding Plunger, Packing Rings and Glands.

Yarway Valve is made in iron for blow-off pressures up to 200 psi., and in steel for pressures to 400 psi.

YARWAY **BLOW-OFF VALVES**

PROBLEMS FROM THE PLANT

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

CAN AUTOMOBILE ENGINE BE CONVERTED TO AIR COMPRESSOR?

SEVERAL OLD automobile gasoline engines have been knocking around our plant for the past few years. We want to put them to work. We have no immediate need for an engine, but we could put an air compressor to good use. What we want to do is convert one of the auto engines to an air compressor.

If this can be done, our first load will be a jackhammer that takes about 100 cfm at 100 psi. We are not sure whether it would be best to (1) run the engine as a combination engine and compressor, by using several of the cylinders as the compressor, or (2) convert the engine completely to an air compressor. After reading many of the answers that POWER readers have sent in to past questions, I am sure they will get me started on the right track. I might add that we have all the tools and mechanical skill necessary to make any changes.—*CK*

READERS' ANSWERS

Should Unit Heaters Be On High-Pressure Line?

(This question is from July issue with best answers from readers.)

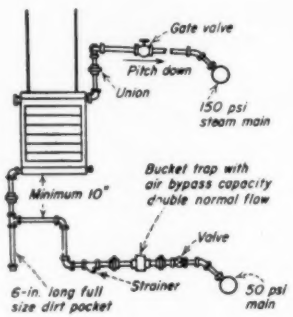
OUR PLANT IS *in the throes of an expansion program that includes adding a new building and heating system. We are set on using unit heaters in this building and are toying with the idea of piping the heaters direct to the high-pressure steam supply. We may then use the exhaust as supply for plant process.*

Sketch to right [see sketch, p 126, July POWER*] shows rough layout of the steam supply system we will install. We will generate steam at 150 psi and deliver it to our boiler auxiliaries such as turbine-driven fans and feed-water pumps. From there we will run to a reducing valve to drop the steam pressure to 50 psi, then feed it to a header. In addition to the plant process tap we will come off the 50-psi header to another reducing valve, which drops the steam further to 5 psi.*

We have heard much about the merits of using a high-pressure steam supply to unit heaters and applying the exhaust to process. Would it be wise to use 150-psi steam for our unit heaters and exhaust direct to the 50-psi header? We would like POWER *readers to give us the benefit of their experience.*—JC

Heater Operation Analyzed Under Both Pressures

IT IS PRACTICAL to tap unit heaters direct to high-pressure line from standpoint of heater operation. But from almost every other angle the answer is No. Heaters are usually tested at pressures of 200 psi. Traps and fittings are available to operate at the higher pressures even though they may be more expensive than those designed for pressures up to 25 psi. If *JC* wants to connect his heaters, sketch below shows best method of doing it. But it is not a practical way to heat a building.



Heater performance. Consider rating of a typical horizontal-type unit heater taken from a manufacturer's catalogue. Using a 1/20-hp motor at 1080 rpm, this heater moves 1336 cfm at an outlet velocity of 638 fpm. Edr (equivalent direct radiation) rating is 316.5 sq ft. When supplied with steam at 5 psi the outlet temperature is 114.9 F with an entering-air temperature of 60 F. Heat delivered is 79,800 Btu per hr, and condensate is 83.0 lb per hr. Increasing the pressure to 150 psi increases outlet temperature to 161.0 F, heat output to 146,000 Btu per hr, and condensate to 171 lb per hr. At first glance this looks like a large increase in capacity at practically no cost to *JC*. But it really isn't.

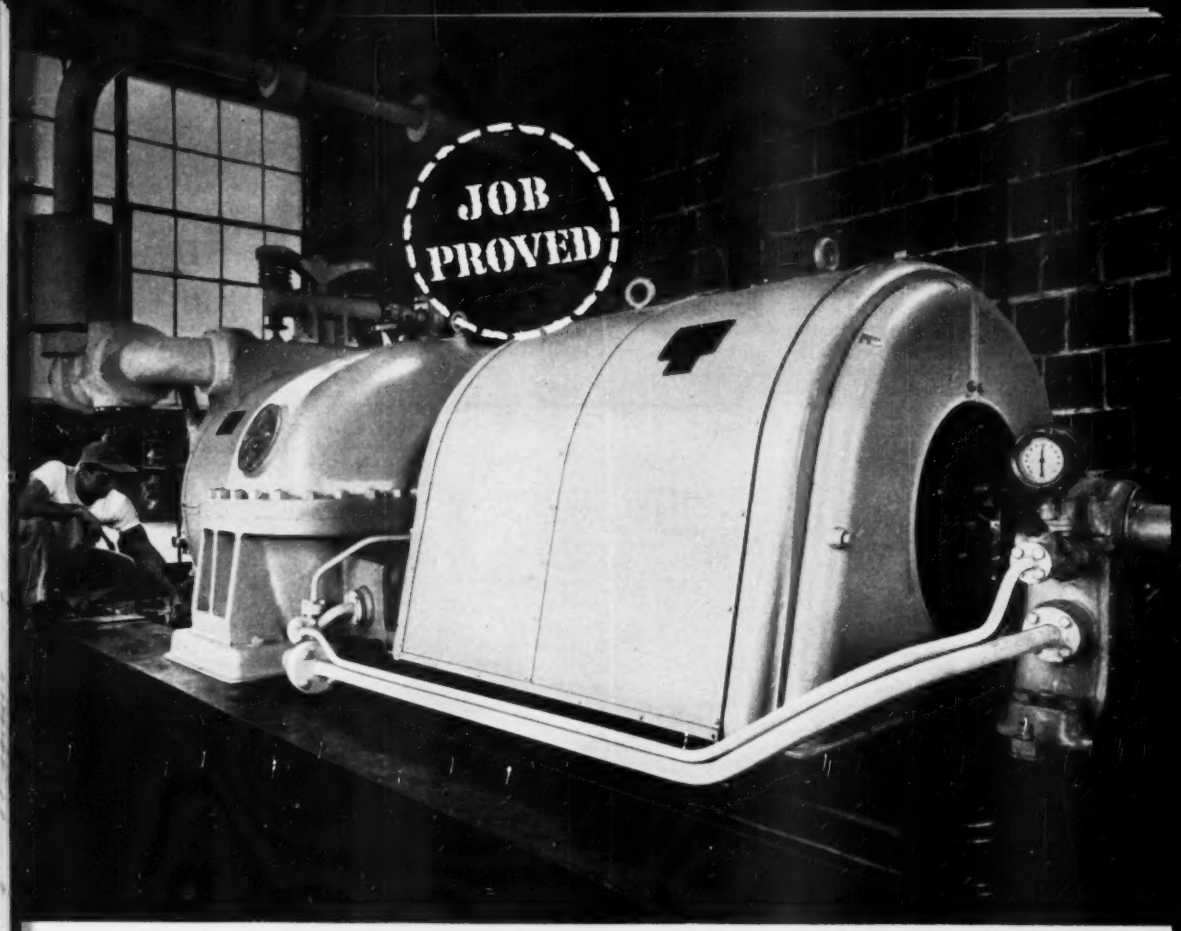
Air leaves the heater at 161 F instead of 114.9 F, but at about equal velocity. That air is going to be pretty hard to handle. If heater is hung low enough to drive air to the floor against its natural tendency to rise, it will make things uncomfortable for anyone working in the air stream. If it is mounted at a reasonable height, air will simply rise to the ceiling. Temperature at roof level will increase with a corresponding increase in heat loss and fuel costs. Actual effective increase in capacity is only about 10%.

Ceiling temperatures may become so high that sprinkler heads will be popping. This can be remedied by setting heads to operate at 280 F instead of the usual 212 F. But that involves an increased insurance premium.

Even down-blast heaters won't overcome this difficulty and they introduce the further danger of baking the motor when fan is shut off and steam pressure left in the coil.

Steam consumption. Yes, use of 150-psi steam results in a 10% increase in capacity with an increase of over 100% in steam consumption. But that isn't all. Only 29% of the steam used in heaters is available for use at 50 psi. The following data drives this point home.

The heater condenses 150-psi steam to water at 150 psi. Total heat of the liquid is 338 Btu per lb. Total heat of saturated steam vapor at 50 psi is 1178 Btu per lb. Thus, only one pound in 3.5, or 29%, is flashed to steam on entering 50-psi main (assuming no



CORROSION THREAT ENDED BY SUNVIS 916

Turbine Under Intermittent Operation Gets Year 'Round Protection

A utility company serving an island summer resort operates an auxiliary turbine at peak capacity throughout the vacation season. But for the rest of the year, this equipment is shut down and corrosion is a constant threat. An oil is required that will keep the equipment running under the heavy summer load, and maintain it ready for instant use in case an emergency should arise during the off season.

More than two years ago, acting on the advice of a Sun engineer who had been consulted, the company filled the circulating system of its turbine with Sunvis 916 Oil. The unit is still running on the original charge and inspection shows complete absence of corrosion.

There has been no perceptible wear of parts. The Sunvis 916 Oil is in excellent condition and only slight make-up has been required to take care of normal leakage.

This is but one of many examples of how "Job Proved" Sunvis 900 Series Oils protect vital and expensive machinery. They are highest-quality, solvent-refined oils, specially manufactured to resist oxidation and sludging, and to protect metal parts against rusting and corrosion. For a copy of the illustrated booklet "Sunvis 900 Oils," write Department P-10.

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superheat in 50-psi main). Remainder must be handled as condensate with another outlay for traps, fittings and pipe.

Heater life. Corrosion in heater tubes will be more rapid at high temperature and pressure because carbonates break down in the boiler under these conditions. Dissolved in condensate, the resulting oxygen and carbon dioxide corrode tubes rapidly. Action is intensified by the higher pressure and temperature under which the heater is operating.

Installation costs. Since high-pressure lines are apparently already available in *JC's* building, insulation need not be considered. Ordinarily it would be an important factor since supply lines would have to be heavily insulated to avoid condensation. It will probably be necessary to install extra drips from 150-psi line to protect coils from damage by condensate in the supply. This is particularly important at end of long pipe runs. While necessity for dripping is not absent from a low-pressure job, cost of traps and fittings is usually lower. Amount of condensate handled can usually be kept low.

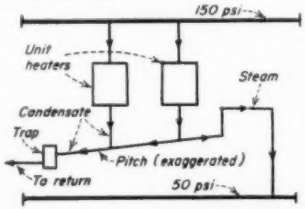
If standard heaters are employed and sized according to their heat output, a saving on heater cost of about 20% may be realized. This may be reduced because of difficulty of locating heaters to avoid uneven heating. Good practice in selecting unit heaters is to size them on both heat output and air volume. An amount of air equal to room volume should pass through heaters every 20 minutes. If this practice is adhered to it is necessary to use special heaters designed for high-temperature steam. These heaters have smaller coils, producing lower temperatures and heat output than standard units at a given pressure. Cost would be about the same as standard heaters so the 20% saving would be wiped out. Difficulties of corrosion, trapping, extra cost of fittings, baking of motors, insulation and utilization of condensate remain unsolved.

Taking the above into consideration the idea appears unsound. One factor that may affect this conclusion is the relative distribution of demand at the various pressures shown. Even at that it would have to be an unusual distribution to compensate for the fact that only 29% of steam used by heaters is ultimately available at lower pressure. *JC* will have a much more satisfactory heating system if he operates his heaters off the 5-psi line. And he won't have to get up a full head of steam to warm his plant on a cold morning!

E H Thring *Toronto, Canada*

Can Use High Pressure

Unit heaters will operate on 150-psi steam. If *JC* is heating outdoor air he may find, during cold-weather periods, condensate instead of steam exhausting to 50-psi line. When heating recirculated air, temperature rise through heater is seldom large enough to produce condensate. Piping arrangement shown below prevents condensate entering 50-psi line.



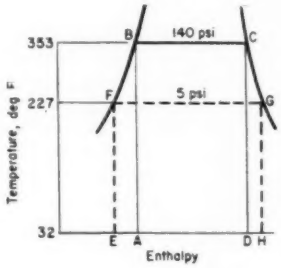
Individual traps cannot be used on each heater; instead, a common trap for two or more heaters should be used. Return line must be pitched away from 50-psi line. Tap between the two should be taken off highest point on return line.

If extreme cold weather is anticipated, *JC* might be better off using 5-psi steam in unit heaters and increasing capacity of 150-to-50-psi reducing valve. Most manufacturers prefer low-pressure steam in unit heaters although operation at high pressures is permissible.

Tyler G Hicks *New York, N.Y.*

High Pressure Expensive

JC's question is predicated on the belief that a unit heater is a heat-extracting and a pressure-reducing device, or a gadget for killing two birds with one stone. It's use in this manner is not recommended.



A unit heater is a condenser, operating on a constant-pressure, constant-temperature principle. Air is the cooling medium that extracts heat from steam.

A unit heater gives up latent heat at pressure and temperature of supply steam. If *JC* supplies steam at 150 psi, or 165 psia (round figures), he will give up 861.35 Btu for every pound. Supply steam has a temperature of 366 F.

I have data on hand for a unit heater to operate at 125 psig. Saturation temperature is 353 F and latent enthalpy, h_{fg}, 868.2 Btu per lb. Capacity of this unit heater is 71,000 Btu per hr and condensate 82 lb per hr. Suppose air entering the unit heater is 60 F, then outlet temperature is 164 F. The unit heater would have to be located high as no one would be able to stand such a blast of hot air. Temperature differential between entering and exhaust air is 164 – 60, or 104 F.

Let us take a low-pressure unit heater connected to 5-psi pressure line. Saturation temperature is 277 F, h_{fg}, 1156.3 Btu per lb. Capacity of this unit is 40,500 Btu per hr and condensate only 42 lb per hr. Assuming same condition as before, that is, 60-F inlet air, outlet-air temperature is 119 deg. Temperature difference is 119 – 60, or 59 F. This unit heater can be located much lower without discomfort. The condensate is almost half that of the high-pressure unit. Smaller piping needed, hence less support.

In the sketch to left note that area ABCD is condensate heat for high-pressure unit; area EFGH is condensate heat for 5-psi unit.

J Yavitch *Philadelphia, Pa.*

Recommends Low Pressure

Unit-heater output is based on entering air at 60 F, dry saturated steam at 2 psi, or hot water at 200 F. Suggest *JC* use condensate from turbine and plant process. The temperature will be well over 200 F.

Of course, on this type heating it is necessary to install mechanical vacuum system (condensate return and vacuum pump). This insures good steam circulation and low backpressure on prime mover. Condensate line should be well insulated.

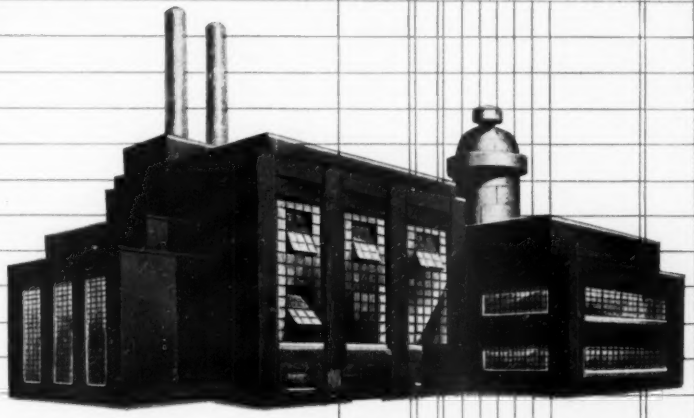
D J Parmer *Quincy, Fla.*

Use Low-Pressure Heaters

JC's question can be answered with the typical "Yes, but . . ." Most unit-heater installations are not designed to produce exhaust-air temperature over 140 F. Unless heaters are designed for steam pressure contemplated (150 psi)

(*Continued on page* 158)

HOW TO PROTECT AN INVESTMENT



A boiler plant represents a sizeable investment . . . an investment requiring the best of protection. Progressive management recognizes that one of the most important phases of such protection is the use of an adequate and well-balanced program of water conditioning. This is the positive way of providing protection . . . to assure economical and efficient plant operation.

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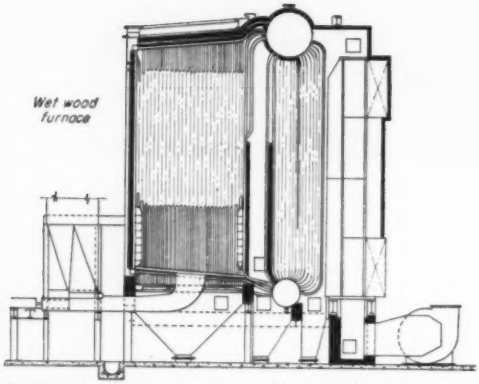
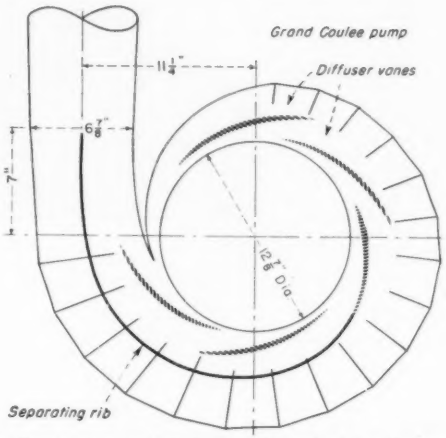
GAS TURBINES: The Gas-Turbine Regenerator • Aircraft Gas-Turbine Installation Considerations • Design of Heat Exchangers for the Regenerative Cycle Aircraft Turboprop Engine

ELECTRICITY: When Should a Generator Be Rewound?—Operating Experiences • Equivalent Circuits for Power-Flow Studies

Directions for ordering papers are given on page 124



1 Underfeed method for wet-wood firing employs a reciprocating ram to push wood into single-stage furnace, above



2 To obtain a uniform flow at the end of the discharge cone a single separating rib in the center gave best results

FUELS AND FIRING

SOME RECENT DEVELOPMENTS IN BURNING WET WOOD, *by Otto Di Lorenzi, Combustion Engineering-Superheater, Inc.* Use of the 2-stage furnace, comprising a dutch-oven and a secondary combustion chamber, has been generally accepted as standard for "hog fuel" and other kinds of wet-wood refuse. Large-scale experimental installations of single-stage furnaces are in operation, using either underfeed or spreader-stoker firing.

Wet wood is so largely a byproduct factor in the manufacture of lumber, pulp and paper and the so-called naval stores that it represents a widely available refuse fuel. And burning it well is of major importanec.

Lumber mills most frequently use dutch-oven furnace designs. The oven section dries and begins the gasification of the wet wood. The secondary chamber carries out the combustion of the gaseous products. Wet-wood burning is so largely a matter of surface combustion that use of refractory in arches and walls in the primary furnace is considered very necessary.

But Fig. 1 shows a different furnace design for this service. It consists of a single-stage furnace 20 ft. high. A grate 8 ft wide by 8 ft long occupies the lower part. It receives wet wood by an underfeed method through a special retort. A reciprocating ram moves the wood from a hopper or bin through the conveyor pipe of the stoker to the retort.

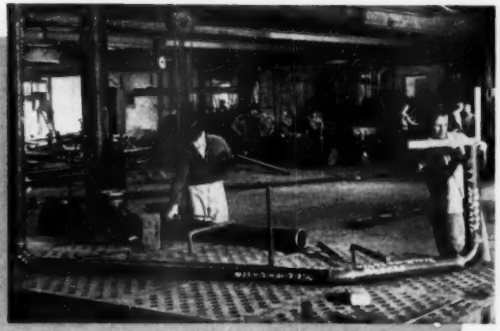
The fuel burns in a pile, but instead of being continually showered downward it is gradually forced upward through the pile from the retort. The external stoker hopper serves as a surge bin to take care of variations in wood supply from the conveyor. Air for combustion is supplied undergrate, as well as overfire by a forced-draft fan.

Series of performance figures for this design shown in table form, *ASME Paper No. 49-SA-31.*

HEALTH ASPECTS OF AIR POLLUTION, *by A J Lanza, MD, Council of Industrial Health, American Medical Assn.* In factories, workshops, mines and all other places where men are gainfully employed, air pollution occurs. It is possible to control such pollution and, in fact, control the air itself by washing or cleansing it and regulating its temperature, humidity and movement.

We know the harmful substances present as a result of industrial processes and the amount in the air can be readily determined. We have progressed so far that we can establish standards expressed in maximum allowable concentrations.

But to hope for a chemically pure air is futile. Wherever man goes he pollutes the air either by breathing or from personal habits. As an example, he moves around in millions of cars which, in their mass effect, contribute more to the pollution of the atmosphere particularly at the breathing level than do factory stacks. We mention this to



In the Checking Department, all fabricated assemblies are checked for dimensions, alignment, and conformance to specified tolerances to insure accuracy and proper fitting.

Close-up photo of pipe cleaning operation.

Taking a Brinell reading of a weld. This is typical of the care that is exercised by Shaw inspectors in every operation in the fabrication of your order.

The Shaw Test Alley is equipped with facilities for hydrostatic testing up to 5,000 lbs. per square inch. This photograph gives you a good idea of Shaw's spacious modern plant facilities.

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President

SHAW PIPING FABRICATION

does not stop with just a weld or a bend

The name Shaw means quality fabrication. At Shaw, we do not consider a job completed when a weld or bend is made. Shaw fabrication is a finished product—checked, cleaned, inspected, tested, accurate—the way you want it. This accuracy and dependability reduce your installation time and costs. The Shaw action photographs shown here are proof that Shaw finishes the job.

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KNOWN SINCE 1893 for HIGH-QUALITY PRE-FABRICATION AND PIPING INSTALLATION

introduce a leaven of common sense into the discussion of atmospheric pollution.

Ever since man left the Garden of Eden he has been faced with atmospheric pollution. Now that industrial expansion has made us acutely aware of atmospheric pollution we must understand the problem clearly so we don't fall victim to needless fears and worries.

On rare occasions Mother Nature has played us false. Witness the chain of circumstances that made the recent Donora, Pa. episode and the earlier fatalities in the Meuse Valley in Belgium in 1930. Los Angeles has a smog condition of a much less harmful nature.

But the amount of disability and mortality from pollution of industrial origin is exceedingly small—so small it could not be identified in any statistical tabulation of causes of death or disability. It is not true that our communities contain lethal or disabling amounts of a large variety of toxic substances poured out upon a defenseless community by neighboring industries. Smoke pollution has become the occasion for a great many loose and injudicious statements. *SPA Paper, no number.*

HYDRO POWER

HISTORY AND DEVELOPMENT OF THE GRAND COULEE PUMPING PLANT, *by E B Moses, mechanical engineer, hydraulic machinery division, U. S. Bureau of Reclamation.* A brief history of the Grand Coulee Basin Project as far as it relates to the Grand Coulee pumping plant is given, followed by a general description of the plant and operating methods. This pumping plant, just upstream from Grand Coulee Dam, will raise water from Lake Roosevelt, a maximum height of 363 ft to the regulating reservoir in the Grand Coulee. From there it will be distributed for irrigation purposes over about 1,000,000 acres by an extensive system of canals and ditches.

At present six pumps are being built, the ultimate installed capacity being 12 pumps of 1445 cfs, each under a rated head of 310 ft, and each driven by a 65,000-hp synchronous motor at 200 rpm. Size of these pumps and ultimate installed capacity far exceeds any pumps or pumping plant now in operation. To insure a satisfactory hydraulic design for a project of this magnitude, an extensive series of tests were run on models of the intake structure, suction tubes, and pumps over a period of years. From this data the final design was established.

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources:

American Society of Mechanical Engineers' semiannual meeting, San Francisco, Calif., June 27-30, 1949. Papers are identified by number and initials ASME. Available from ASME, 29 W 39th St, New York 18.

American Institute of Electrical Engineer's semiannual meeting, San Francisco, California. Aug 23-26, 1949. Winter general meeting, New York, N.Y. Jan 31-Feb 4, 1949. Papers are identified by number and initials AIEE. Available from AIEE, 29 W 39th St, New York 18.

Smoke Prevention Assn. of America, 42nd annual meeting, Birmingham, Ala., May 23-27, 1949. Papers identified by initials SPA. All papers published in bound volume through C D Behan, 139 N Clark St, Chicago, Ill.

The preliminary designs of the pumps, as furnished by several manufacturers, indicated that a prototype speed of 150 rpm would be required. This resulted in a very large pump having an impeller diameter of approximately 218 in. with a corresponding large casing and a specific speed of about 82.

From tests on the preliminary model it was found that the prototype speed could be safely increased to 200 rpm with a reduction in impeller size to 168 in., and a corresponding increase in specific speed to 103. With the usual design of volute pumps, the outer casing wall must withstand the bursting effect from the internal pressure produced by the impeller. In small pumps, the cast casing is usually sufficiently heavy to resist deformation without resorting to vanes or struts across the throat. In Grand Coulee pumps, use of exterior ribs around the casing would have been impracticable because of the large volute section and high internal pressures, which in turn would have required massive exterior ribbing to prevent distortion under the high pumping pressures. The alternative was to use stay vanes to tie the casing together across the annular gap at the throat. Unless properly designed, such vanes interfere with the impeller discharge and reduce pump efficiency. The Bureau of Reclamation made an extensive study with a view to utilizing these vanes as diffusers to recover a part of the velocity head induced by the impeller at this point, instead of attempting to recover most of the velocity head in the volute and volute extension. The model test on several designs of diffusers indicated such a design to be practicable accompanied with high capacity and efficiency over the desired range of heads. Cavitation tests also proved that as a result of the uniform distribution of pressure around the impeller, because of the diffuser vane, it was possible to reduce the minimum submergence by 5 ft. This permitted setting the pumps 5 ft higher, resulting in a substantial saving in cost of plant construction. Results of these investigations were the determining factors in the adoption of the diffuser type of pump. This design made possible a more compact foundation, and a considerably smaller pump with corresponding reduction in cost. For the first six units now under construction the saving is of such magnitude as to make cost of investigation work of no consequence. *ASME Paper No. 49-SA-20.*

DEVELOPMENT OF THE HYDRAULIC DESIGN FOR THE GRAND COULEE PUMPS, *by Carl Blom, chief engineer, Byron Jackson Co.* Grand Coulee pumping plant has been the subject of an extensive hydraulic research program. First part of the program was conducted at the California Institute of Technology for the Bureau of Reclamation from January 1938 through July 1940. This paper presents some of the results of continued experiment research of the author's company from 1943 to 1946. The investigation covered the effects of various diffuser-type pump cases and impellers on the pump characteristics of Grand Coulee model, Fig. 2, p 122.

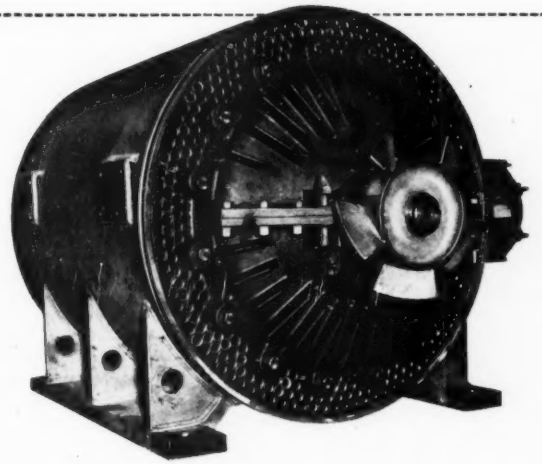
From these tests conclusions are reached that:

1. The pump casing has a great influence on pump performance. Pumps with single-volute, double-volute and diffuser casings designed on the same basis will perform differently. Also, the number of diffuser vanes in the casing has an influence on the unstable portion of the performance curve. Fewer diffuser vanes reduce the magnitude of the dip in the head-capacity curve. The diffuser casing inlet affects the shape of the head-capacity curve and also the pump-efficiency curve. Six diffuser vanes seem to be the minimum number for practical design of a welded pump diffuser-casing structure that will give a casing sufficient strength and also allow a reduction in its weight. A dividing rib in the diffuser case gives better velocity distribution and improves pump efficiency.

2. Impellers with the same profile, but with different impeller-outlet vane angles, materially affect pump size and weight. The steeper vane angle gives a flatter performance curve and produces a more pronounced dip in the unstable head-capacity range.

3. The impeller-inlet vane design has a great influence on the cavitation

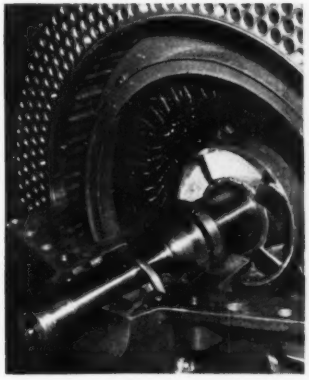
ANACONDA copper tubes in stator yoke solve explosion-proof motor design problem

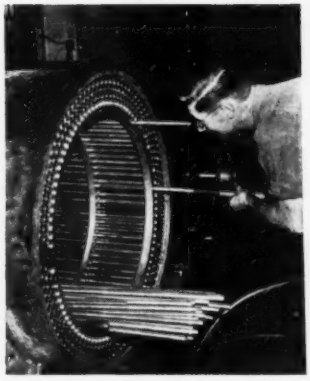


Getting rid of heat has always been a major problem in motor design. But in an explosion-proof motor that problem is really tough. The cooling system developed in the new 400-hp. 2300-volt Allis-Chalmers Explosion-Proof Tube-Cooled Motor, shown here, solved the problem neatly. It is entirely self-contained. Requires no water flow. Contains no inert gas. Just air.

Rapid, adequate heat transfer is effected by circulation of the sealed air. Cooling air is continuously forced through the copper heat transfer tubes mounted in the stator yoke. Simple, efficient, dependable.

Good ideas and the right materials can give alert manufacturers a big competitive advantage. ANACONDA Copper and Copper Alloys—and the experience of ANACONDA technicians—help solve many critical design problems in the electrical industries. May we help solve yours? Tell us about it. Your inquiry will be handled promptly, competently and confidentially by our Technical Department. Please address The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.





400-hp. 2300-volt explosion-proof motor designed and built by Allis-Chalmers Manufacturing Company. Internal fans on the rotor shaft circulate sealed air around the ANACONDA Copper cooling tubes shown here. At the same time, room air is forced through the tubes by an external fan mounted on one end of the rotor shaft. Thus internal heat is rapidly, effectively and safely dissipated.

For copper and its alloys . . consult **ANACONDA**

characteristics and also affects the unstable portion of the head-capacity and horsepower curves. A flat entrance vane angle reduces the head and horsepower at closed valve, and also improves pump efficiency at lower capacity.

4. The unusual performance of Grand Coulee pumps was a challenge to existing knowledge and techniques. To obtain desired results, careful testing was required, and use of the latest testing equipment was necessary. *ASME Paper No. 49-SA-8.*

MECHANICAL DESIGN AND CONSTRUCTION OF THE GRAND COULEE PUMPS, *by Ira Morgan White, manager of engineering, the Pelton Water Wheel Co.* When working up designs for a mechanical structure that would comply with the hydraulic considerations necessary for the Grand Coulee pumps, many compromises were required. Certain types of pumps were more favorable from the standpoint of the hydraulic considerations alone, while others were more favorable from mechanical considerations alone. A balance had to be established that would permit a pump design that would be safe as to hydraulic design requirements, and still of simple enough mechanical design, so weight and cost would be held to a minimum.

Studies were made on single-suction single-discharge pump casings for (1) standard-volute casing (2) double-volute casing (3) four-vane diffuser casing (4) six-vane diffuser casing, and (5) twelve-vane diffuser casing.

Extensive studies made jointly from hydraulic and mechanical considerations yielded a compromise on the basis of a six-vane diffuser-type pump as being the one that would comply safely with hydraulic consideration, and be nearly the simplest and least costly design from a mechanical standpoint.

Conclusions are reached that the development of the design for the Grand Coulee pumps has shown that:

1. The conventional type of pump with its standard volute casing is impractical for very large pumps.

2. The double-volute pump saves considerable weight, but is not comparable to the multiple-vane diffuser pump, which gives about the best mechanical design.

3. Optimum construction from the mechanical standpoint is the 12-vane diffuser pump. But hydraulic design requirements made necessary the 6-vane pump to obtain hydraulic stability through the head range of 270 to 365 ft.

4. The combination cast-steel diffuser section with the welded plate-steel volute provides an economical casing construction.

5. Use of flanges maintaining full face contact is advantageous from a weight and stress standpoint.

6. The strain gage method of analyzing complex structures yields valuable information in mechanical design.

7. The period from initial planning of first test to the time when field tests will be made on the first large pump will be about 15 years. The war added materially to this interval. But the actual time, other than war years, indicates the magnitude of the problem, and the extreme caution with which everyone has proceeded in the designing of pumps many times larger than any previously manufactured. *ASME Paper No. 49-SA-21.*

GAS TURBINES

THE GAS TURBINE REGENERATOR — THE USE OF COMPACT HEAT TRANSFER SURFACES, *by A L Landon, W M Kays, Stanford University.* The high-efficiency gas-turbine plant, unlike other prime-mover systems, requires a design philosophy of close attention to details in all respects. This insistence on optimum design has to be because (1) operation is at temperatures approaching metallurgical limits (2) flow rates of the working substance are large (3) the high "backwork" input to the compressors multiplies the costs of flow-friction power (4) machinery arrangement must be compact.

During the present pioneering development of the gas-turbine system little attention has been devoted to heat-exchange components, primarily the regenerator. For a gas turbine having a specific fuel consumption over a fairly wide load range comparable to that of a steam plant, a regenerator of considerable specific transfer area is required.

In an open-cycle plant a transfer area of the magnitude of three to four sq ft per rating is needed. This requirement is several times that of the boiler plus condenser of a steam power plant. So it is evident that if compactness and light weight are to be realized boiler or condenser types can't be used.

This discussion emphasizes the ultimate necessity of regenerator heat-transfer surfaces having substantially higher area to volume ratio characteristics than conventionally used boiler and condenser-tube banks. Thus attention is directed to the use of either small circular or flat tube surfaces of the order of ¼-in. hydraulic diameter, or else extended surfaces. For the latter, construction will have to be of such a nature that extended areas are on both the hot and the cold gas sides. The reason for this is each heat-transfer film resistance is of the same order of magnitude, and coefficients are sufficiently low to permit satisfactorily high temperature effectiveness for the fin surfaces. *ASME Paper No. 49-SA-9.*

AIRCRAFT GAS-TURBINE INSTALLATION CONSIDERATIONS, *by Benjamin T Salmon, Consolidated Vultee Aircraft Corp.* Installation of any of the several types of aircraft gas turbine in an airplane involves the integration of a highly sensitive air pumping machine into the over-all design of an aircraft. The complete power plant that results derives its full share of benefits from the flight characteristics of the aircraft as a whole.

Evaluation and design treatment of the many governing considerations involved rests in the hands of the original aircraft designer. Upon the soundness of his design judgment depends the success of the complete aircraft and the power plant whose heart is the gas turbine.

Aircraft gas turbines may be classified in two broad categories: turboprops and turbojets. Purpose of this paper is a discussion of several installation considerations governing the application of different types within these two broad groups. While some of the installation considerations are similar a great many of the detail aspects are quite different so very little in the way of parallels can be drawn.

Fundamental installation similarities concern problems of (1) gathering and ducting great quantities of air to the compressor inlet (2) disposing of large masses of high temperature exhaust gases to derive the greatest possible amount of useful work (3) supplying filtered fuel at high flow rates and moderate pressure (4) mounting the engine to give good accessibility for service.

Differences concern control, propeller and accessories, oil cooling, power-plant location. *ASME Paper No. 49-SA-17.*

DESIGN OF HEAT EXCHANGERS FOR THE REGENERATIVE CYCLE AIRCRAFT TURBOPROP ENGINE, *by F E Romie, A G Guibert, C D Coulbert, University of California.* Thermal efficiency of a gas-turbine engine can be increased by the addition of a heat exchanger for regeneration. This increase in thermal efficiency is purchased at the price of a decrease in engine-power rating because of pressure losses through the exchanger. The engine is also made heavier and large.

For a stationary or marine installation these factors are subject to a fairly simple analysis as compared to an air-

(Continued on page 146)

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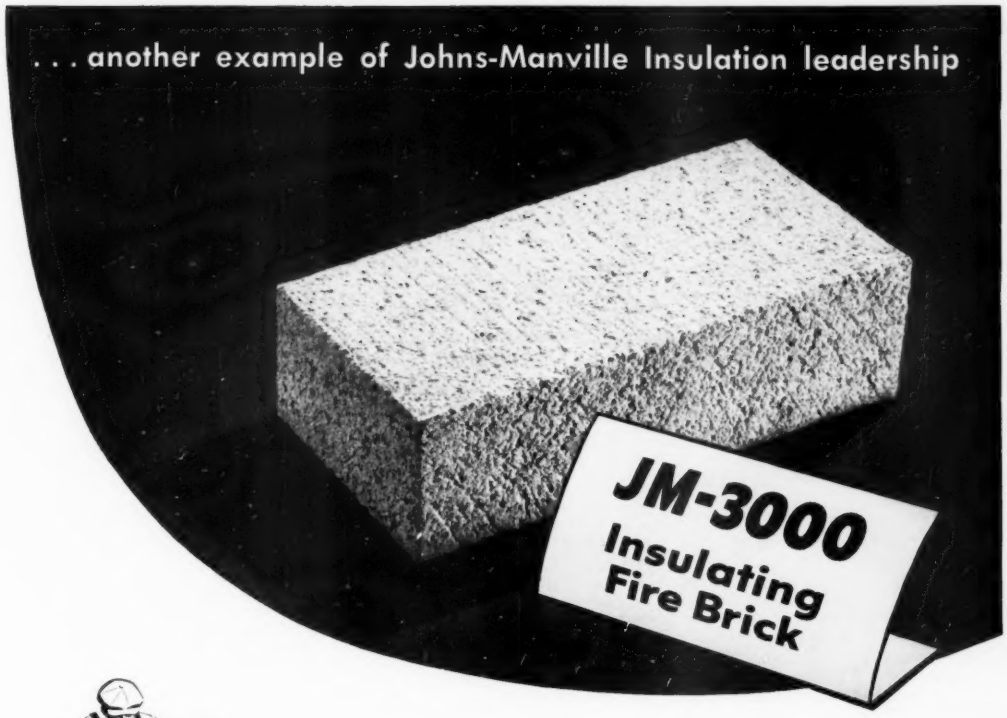

HERE IS A NEW insulating fire brick that truly deserves the spotlight.

It stands alone . . . for it is the only insulating fire brick made to withstand the intense heat of a full 3000F—and to *take* that temperature through long operating cycles. Important among its many advantages to industry are longer life, greater fuel savings and substantial savings in downtime.

Like other Johns-Manville Insulating Fire Brick, it too, is light in weight, has low conductivity and high heat resistance. J-M Insulating Fire Brick is equally efficient as back-up insulation, and as a direct refractory for furnaces, kilns and other types of high temperature equipment.

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Why not call a Johns-Manville Insulation Engineer about your next insulation job. Let his experience assure you the highest dividends on your insulation investment.

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POWER NEWS

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WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

Shale-Oil Refinery Goes Into Operation

►ANNOUNCING COMPLETION of the first continuous shale-oil refinery in this country, James Boyd, director of Bureau of Mines, said recently that the new 200-barrel-a-day experimental unit near Rifle, Colo., has been put "on stream" without difficulty.

A highly flexible, continuous unit, the refinery is designed to produce gasoline, diesel fuel, heating fuels, and fuel gas from crude shale oils extracted at the bureau's oil-shale demonstration plant. It was built under contract with Refinery Engrg Co of Tulsa, Okla., at a cost of $244,912.

Commercial utilization of the nation's gigantic oil-shale resources is a 3-fold problem, Boyd stated, involving (1) mining the shale (2) retorting the shale to produce oil, and (3) refining crude shale oil into useful products. Operation of this new experimental unit under the bureau's synthetic fuels research and development program is expected to answer for private industry some of the technical and cost questions of shale-oil refining. The mining problem has been largely solved, for the bureau's experimental oil-shale mine

(Continued on page 192)

COMING EVENTS

Oct 3-4—National Assn of Corrosion Engineers, South-Central region meeting, Adolphus Hotel, Dallas, Texas. G R Olson, United Gas Pipe Line Co, Box 1407, Shreveport 92, La.

Oct 3-5 — National Lubricating Grease Institute, annual meeting, Hotel Roosevelt, New Orleans, La. Harry F Bennetts, NLGI, 4638 Mill Creek Parkway, Kansas City 2, Mo.

Oct 6-7—Prime Movers Committee, Pennsylvania Electric Assn, Hotel Edison, Sunbury, Pa. John W Mikels, chairman, c/o Pennsylvania Power Co, 19 E Washington St, New Castle, Pa.

Oct 16-21 — American Welding Society, 1949 annual meeting, Hotel Cleveland, Cleveland, Ohio. M M Kelly, secretary, American Welding Society, 33 W 39th St, New York 18, N. Y.

Oct 17-19—Engineers' Society of Western Pennsylvania, tenth annual water conference, Hotel William Penn, Pittsburgh, Pa. H M Olson, chairman, water conferences, ESWP, Hotel William Penn, Pittsburgh, Pa.

Oct 17-21—National Metal Congress and National Metal Exposition, Public Auditorium, Cleveland, Ohio. Walter Morrison, 7301 Euclid Ave, Cleveland 3, Ohio.

Oct 26-27—Coal Div, American Institute of Mining and Metallurgical Engineers, and Fuels Div, American Society of Mechanical Engineers, twelfth joint meeting, French Lick Springs Hotel, French Lick, Ind. J S Bond, chairman, publicity committee, c/o Enos Coal Mining Co, 1405 Merchants Bank Bldg, Indianapolis 4, Ind.

Nov 10-11—National Air Pollution Symposium, sponsored by Stanford Research Institute in cooperation with California Institute of Technology, University of California, University of Southern California, Huntington Hotel, Pasadena, Calif. A M Zarem, chairman, Room 332, 612 Flower St, Los Angeles 14, Calif.

Nov 14-18—Refrigeration Equipment Manufacturers Assn, 6th all-industry air-conditioning and refrigeration exposition, Atlantic City Auditorium, Atlantic City, N. J. George E Mills, show director, 1346 Connecticut Ave, Northwest, Washington 6, D.C.

Nov 28-Dec 3—22nd Exposition of Chemical Industries, Grand Central Palace, New York 17, N. Y. Charles F Roth, International Exposition Co of New York, Grand Central Palace, New York 17, N. Y.

Railway Company Orders New Coal Burning-Locomotive for Freight Service

Norfolk and Western Railway Co has ordered a new type coal-burning, steam-turbine, electric-drive locomotive, to be built by Baldwin Locomotive Works, Westinghouse Electric Corp and Babcock & Wilcox Co. Rated at 4500 hp, it is designed for operation in freight service. The design will make use of high boiler pressure combined with efficiencies inherent in the steam-turbine electric drive to produce an over-all thermal efficiency that will cut fuel costs, it is estimated, to one half that of conventional reciprocating steam locomotive. The boiler will be of the watertube design to produce a steam pressure of 600 psi. The locomotive will have a separate water-carrying tender of 16,000-gal capacity. Locomotive and tender together, in working order, will weigh about 952,000 lb and will have an over-all length of about 148 ft

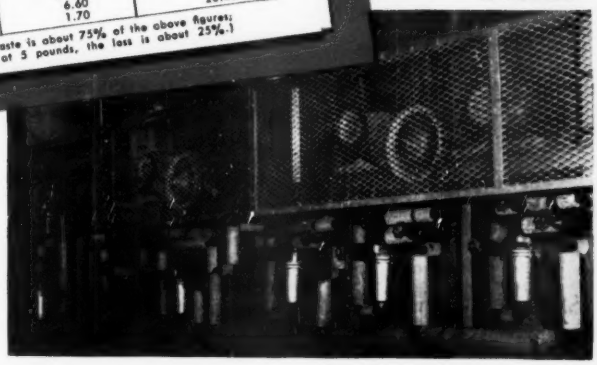
SMALL STEAM LEAKS *add up!*

Showing cost of various sized steam leaks at 100 pound pressure. (Assuming steam costs 50 cents per 1000 lbs.)

Size of Orifice	Lb. Steam Wasted Per Month	Total Cost Per Month	Total Cost Per Year
1/2"	835,000	$417.50	$5,010.00
3/8"	470,000	235.00	2,820.00
1/4"	210,000	105.00	1,260.00
1/8"	52,500	26.25	315.00
1/16"	13,200	6.60	79.20
1/32"	3,400	1.70	20.40

(For steam at 50 pounds pressure, the waste is about 75% of the above figures; at 20 pounds, it is about 50%; and at 5 pounds, the loss is about 25%.)

SEE OUR CATALOG IN SWEET'S

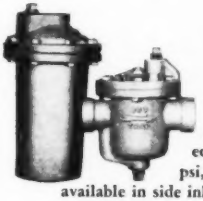


TYPICAL FUEL SAVINGS SECURED WITH ARMSTRONG TRAPS

20% FUEL SAVINGS after trapping all heating coils individually. — Norton Greenhouses, St. Paul, Minn.

33-1/3% REDUCTION IN ANNUAL COAL BILL after installing Armstrong traps on cooking vats. — Ralph L. Smith Lumber Co., North Kansas City, Mo.

3,728 GALLONS OF FUEL OIL SAVED in one year after replacing old traps with Armstrongs on kettles, low pressure heating system and cream beaters. — Mary Lincoln Candies, Buffalo, N. Y.



STEAM SAVERS:

For trapping heating systems and process equipment from 1 to 250 psi, Armstrong Traps are available in side inlet—side outlet or bottom inlet—top outlet body styles. These compact, dependable traps provide more actual hot condensate capacity per dollar of trap investment than any other traps on the market. For selection data, capacities and prices SEND FOR the 36-page ARMSTRONG STEAM TRAP BOOK.

CHECK YOUR STEAM TRAPS *now!*

The chart above shows that a "little" steam leak can cost a lot—and a hundred or a thousand little leaks cost a lot more! No plant can afford the luxury of leaky steam traps. It costs far more to keep them than it does to replace them with modern Armstrong Inverted Bucket Steam Traps. Armstrong Traps won't leak steam because:

1. The valve and seat are ground and lapped to a precision, steam-tight fit.
2. The valve is water-sealed at all times.
3. Both the valve and seat are made of chrome steel, heat treated for long life and corrosion and erosion resistance.

With today's high fuel and operating costs Armstrong traps are priced lower in proportion to the savings they can effect than at any time in their history. Let your nearby Armstrong Representative help you select the traps you need or write direct to the factory.

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ARMSTRONG *Inverted Bucket* STEAM TRAPS

Factory Representatives in 48 Key Cities... Traps Stocked at 147 Points

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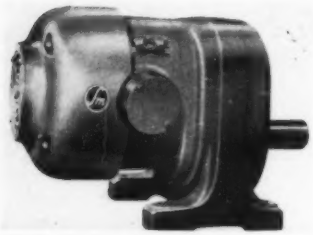
Published monthly as a service to readers



P1005 • GEARED MOTOR—An external fan forces cooling air over streamlined motor case. Type *FWFB* is a totally enclosed geared motor and is suitable for atmospheres containing nonexplosive dusts, vapors and injurious foreign materials.
Sterling Electric Motors, Inc, Los Angeles, Calif.

P1052 • WATER FEEDER—No. 21 and 121 makeup water feeders are designed specially for service on the receiving tanks of boiler return systems. Straight-thrust cam-and-roller valve action provides tight closure against water pressures up to 150 psi.

Feeder is equipped with stainless-steel valve and seat and large strainer, and is made with three patterns of mounting flanges. Primary use of this feeder is in combination with a float switch on the boiler for starting and stopping the condensate pump to maintain proper boiler-water level.

McDonnell & Miller Inc, Wrigley Bldg, Chicago 11, Ill.

P1026 • SPEED LIMITER—Simple, accurate and reliable speed-limiting device for service with motors, generators and mg sets is adaptable to an extended speed range, from 100 to 2000 rpm.

Speed limiters are built with weight and tension-spring combinations to suit particular speed ranges within the over-all range. Improved design results in an accuracy of about ±2% for higher speeds and ±5% for lower speeds.

Device is suitable for horizontal and vertical operation. Its rotating element is balanced about the axis of rotation to assure freedom from vibration. A trip-arm guard prevents accidental actuation of tripping mechanism. While each speed-limiting device is normally set at the factory for operation at about 15% overspeed for rated speeds up to 500 rpm and 10% overspeed for higher rated speeds, adjustments can be made in the field, if necessary.
Allis-Chalmers Mfg Co, Milwaukee.

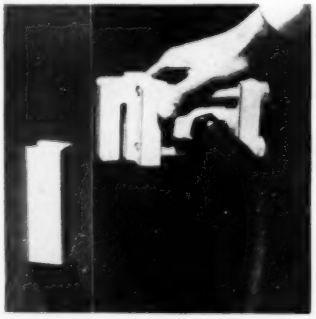
P1053 • COMPRESSOR CONTROL—*UL*-83 *Drill-More* regulator automatically varies compressor speed by adjusting the engine governor spring.

UL-83 regulator is much simpler in operation and easier to adjust than the original multispeed regulator used on all Ingersoll-Rand 105-cfm and larger portable compressors since 1939. Average air pressures are 15 to 20 psi higher, and savings in fuel are 40%. Regulator varies compressor capacity throughout entire speed range without speed steps or cycling.
Ingersoll-Rand Co, Phillipsburg, N.J.

P1029 • TURBINE PUMP—Improved turbine pump has impeller fastened firmly to an enlarged shaft by a locknut and woodruff key, eliminating metal-to-metal contact. It features sealed-in-grease ball bearings.

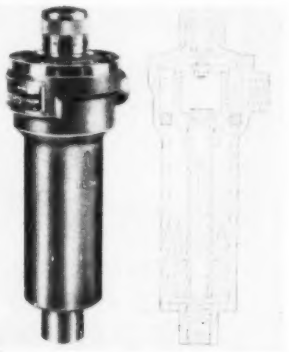
This design avoids dangers of bearing rust or improper lubrication. Bearing end play is eliminated by pre-loading spring under outer adjusting nut. Spring is adjusted to exact tension recommended by manufacturer. Freedom from end play insures absolute location of shaft and impeller, manufacturer states. Properly adjusted, impeller will never touch side plate.

Other features include: development of high pressures in single-stage construction; heads and impellers that are renewable when capacity of pump is to be changed.
Roy E Roth Co, Rock Island, Ill.



P1044 • PNEUMATIC VIBRATOR—Type *UH* pneumatic vibrator may be quickly attached to and removed from units where vibrator installation cannot be permanent. However, vibrating mechanism is designed to withstand continuous use.

Type *UH* vibrator is equipped with a rugged milled steel hook. Female brackets, designed to receive and securely hold the vibrator hook, are obtainable for welding or bolting to item to be vibrated. Unit is available in a 2-in. piston diameter size and operates efficiently on 50-to-100-psi continuous line pressure. Number of vibrations per minute and intensity of vibration can be controlled by regulating air pressure. It weighs 14 lb, is 6¾ in. long, 4 in. high and 3½ in. wide, and is equipped with a swivel hose fitting designed to receive ½ in. ID hose.
Cleveland Vibrator Co, Clinton Ave, Cleveland 13, Ohio.



P1054 • FLOW REGULATOR—Unit uses no pressure pipes, diaphragm or motor-operated external valve, springs or levers. It holds any preset flow volume constant while the upstream pressure may vary over a 100-psig range.

Regulating unit is contained in a vertical cylindrical case, which has a valve seat and disk in partition near its upper end. An opening in center of valve disk forms a differential pressure orifice and a movable disk concentric in this orifice opens and closes a high-pressure valve in the lower part of the case. Thus constant differential pressure (and the constant flow causing it) is regulated by the small central disk and orifice. Change of the opening of the surrounding valve provides variation of flow in direct proportion of area of the opening.
W A Kates Co, Deerfield, Ill.

P1033 • PILLOW BLOCK—Unit-type anti-friction bearing pillow block holds fast with a vise-like grip to shafts revolving at high speeds. Equipped with either ball or spherical roller bearings, block has tapered inner ring and tapered split sleeve which, when ring is pressed against it with a tightening nut, contracts and wraps around the shaft.

Even though shaft may vibrate, concentric grip will not loosen, it is claimed. Use of sleeve eliminates need for lock screws, which may cause burrs on shaft. Unit comes completely assembled and prelubricated for immediate installation and operation. Special floating seals prevent

(*Continued on page* 136)

For further data on above items use reply cards on page 186a, identifying your request with letter *P* and number

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60,000 Times

● To you — if you are one of the 60,000 men who operate more than 8,000 Nalco industrial installations — our sincere *thanks.*

Your confidence in the Nalco System of water treatment is the prime factor in a Nalco record of sound, rapid growth that is continuing in step with Nalco research and its resulting developments of even better water treatment chemicals and procedures.

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6222 West 66th Place **Chicago 38, Illinois**

Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ontario

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How to plan a

CENTRAL PUMPING STATION FOR TRANSFER OF FLUIDS

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

Transfer of fluids within a plant is a major operation in many industries such as food, distilling, brewing, pasteurizing and chemical. The flexible Pumping Station layout shown here, which can be applied to any of these or similar industries, allows fluids to be pumped from tank to tank or to any processing equipment. It also reduces piping to a minimum and eliminates the nuisance of continual hose coupling.

A single pipe line from each tank or piece of processing equipment is run to the pumping station and there connected to the suction and discharge headers of each pump. Although the number of pumps and tank headers may vary according to the plant needs, each tank header must be tied into the suction and discharge headers of all pumps.

Because pollution of one fluid by the remains of the previously pumped fluid is oftentimes harmful to the product, adequate provision must be made for washing pumps, valves, and pipe lines. This may be done by steam, hot water or chemical solutions, depending upon the fluids carried. All headers must have proper drainage facilities and check valves should be installed on drain lines to prevent destructive backflow into the headers. Flow meters are often installed in the pump discharges to measure or regulate the rate of flow and quantity of fluid.

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A Use the right type valve for the service.
B Place valves correctly in the line.
C Choose Jenkins Valves for lifetime economy.

48

Fig. 106-A
Renewable Composition Disc
BRONZE GLOBE VALVE
150 Pounds Steam
300 Pounds O.W.G.

Bronze and Stainless Steel valves are listed for each application and Iron Body Bronze Mounted or All Iron are also available. Shutoff valves are of the O.S.&Y. rising spindle type, so that the operator can tell at a glance if the valve is open or closed.

The valve recommended for this layout is the Fig. 106-A, Jenkins Renewable Disc Bronze Globe Valve. It is designed with a convenient slip-on, stay-on disc holder that permits a quick change of disc. The resilient composition disc assures drop-tight closure. The sturdy screw-over bonnet is unaffected by repeated disassembly and reassembly.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantage of Jenkins specialized valve engineering experience, select all the valves you need from the Jenkins Catalog. *It's your best assurance of lowest cost in the long run.*

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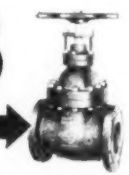
LOOK FOR THE DIAMOND MARK

SINCE 1864



CENTRAL PUMPING STATION FOR TRANSFER OF FLUIDS

TANK "1" HEADER
TANK "2" HEADER
TANK "3" HEADER
TO OR FROM PROCESS AND/OR STORAGE TANKS
STEAM, HOT WATER OR CHEMICAL FLUID FOR WASHOUT
SUCTION HEADER "A"
DISCHARGE HEADER "A"
SUCTION HEADER "B"
DISCHARGE HEADER "B"
SUCTION & DISCHARGE HEADER DRAIN LINE
TANK HEADER DRAIN LINE
PUMP VENT
ORIFICE FLOW METER
PUMP "A"
PUMP "B"
TO DRAIN
HOT WATER OR CHEMICAL WASHOUT FLUID
FLOW ARROWS SHOWN INDICATE TANK "1" BEING DRAINED THROUGH PUMP A TO TANK "3" TANK "2" BEING DRAINED THROUGH PUMP B TO TANK "3"

Diagram by Hanlon Waldheim Consulting Engineer

VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog

Code	Quan.	Jenkins Valves Bronze	Jenkins Valves Stainless	Type	Application
A	6	Fig. 368	Fig. 1302	Gate	Tank Header for Cleaning
B	6	Fig. 368	Fig. 1302	Gate	Suction Header Inlet
C	6	Fig. 368	Fig. 1302	Gate	Discharge Header Outlet
D	1	Fig. 92	Fig. 1328	Swing Check	Prevent Backflow to Washout Line
E	1	Fig. 368	Fig. 1302	Gate	Washout Line Shutoff
F	5	Fig. 106-A	Fig. 1308	Globe	Individual Washout Shut-offs to Tank Headers
G	4	Fig. 368	Fig. 1302	Gate	Pump Suction Shutoffs
H	2	Fig. 92	Fig. 1328	Swing Check	Prevent Backflow to Pump
J	2	Fig. 106-A	Fig. 1308	Globe	Pump Discharge Control
K	2	Fig. 106-A	Fig. 1308	Globe	Pump Vent Control
L	7	Fig. 92	Fig. 1328	Swing Check	

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Number 208

Cooling Water for Ammonia Condensation

► To figure the cooling-water flow needed to condense ammonia in a refrigerating system the discharge pressure and temperature from the compressor must be known. Water flow depends also on its temperature rise through the condenser. Usually temperature of the condensed ammonia is close to saturation. Chart at the right assumes this to be the condition. If any large amount of subcooling of ammonia liquid occurs a correction can be made easily.

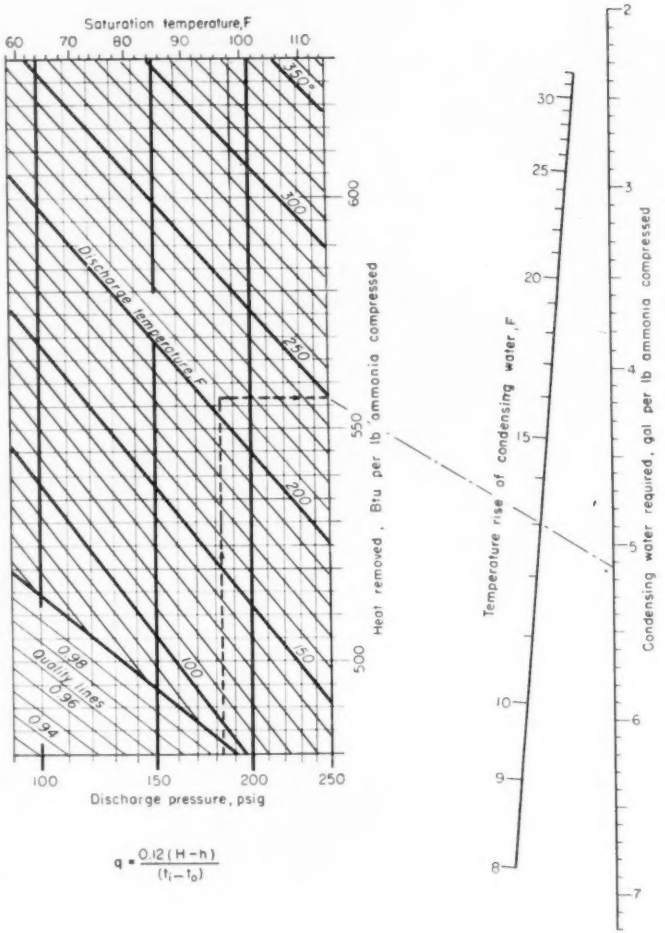
To use the chart simply follow the trace to find the heat removed per lb of ammonia. Then align this value with the temperature rise of the cooling water on a straight edge. Read the cooling water needed per lb of ammonia at the intersection on the right-hand scale.

Example: Ammonia pressure and temperature leaving the compressor is 183 psig and 206 F. Cooling-water temperature increases by 13 F through the condenser. Find the cooling water flowing.

Find 183 psig on the bottom scale, follow trace to 206 F, then right to find 557 Btu removed per lb of ammonia. Lay straight edge on this point and on 13 F on middle scale. Read 5.13 lb condensing water per lb of ammonia on right-hand scale.

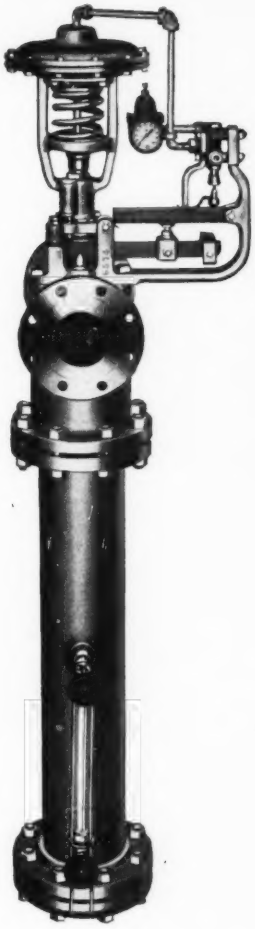
Suppose that liquid ammonia temperature leaving condenser is 70 F. At top of chart find saturation temperature of 96 F corresponding to 183 psig. Liquid ammonia is subcooled 96—70 = 26 F. The additional heat removed above the saturation enthalpy is then $26 \times 1.13 = 29$ Btu. Correction to cooling water is $29/557 = 0.052$. Total water is then $5.13 \times 1.052 = 5.4$ lb per lb ammonia.

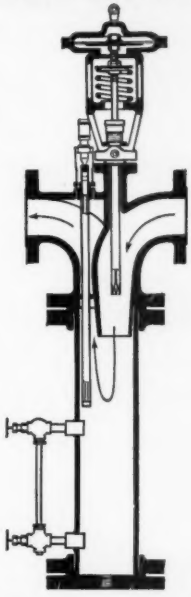
By John F Hyam *Sarnia, Ontario*



$$q = \frac{0.12\,(H-h)}{(t_1-t_0)}$$

Self-Contained DESUPERHEATER





Cooling water completely atomized at all rates of flow . . . final steam temperature held closely . . .

Easily installed, the COPES Desuperheater holds the final steam temperature within plus-or-minus 5 degrees F., regardless of changes in initial temperature or rate of flow. Self-contained, it has no outside valve controlling flow. Complete atomization of the cooling water is assured by controlling its flow at the spray nozzle, across which pressure drop is held constant. Intimate contact of water and steam is at point of greatest turbulence in mixing chamber. Write for descriptive Bulletin 405-A.

NORTHERN EQUIPMENT COMPANY
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Representatives Everywhere

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COPES furnishes pressure-reducing and desuperheating stations designed and built for the individual installation. COPES also builds-to-measure boiler superheat controls responsive to both steam flow and temperature.

COPES

Headquarters for . . .

Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

EQUIPMENT NEWS *CONTINUED*

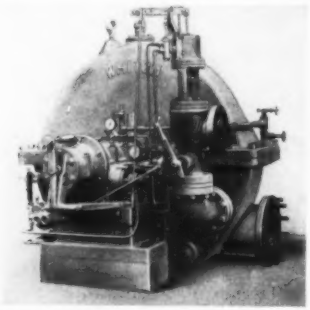
leakage of lubricants and entrance of dirt and other foreign matter into bearing. Pillow block is available in either "free" or "held" types and in shaft sizes from 1 7/16 to 2 7/16 in.

SKF Industries, Inc, Philadelphia, Pa.

P1040 • ROOF VENTILATOR — Round stationary-type unit for general ventilation embodies design features that assure high efficiency. Manufacturing economies permit distribution at a moderate price.

Known as *Valvent*, this ventilator is made in five throat sizes—12, 18, 24, 30 and 36 in. Big feature is combination damper and inverted-cone air guide that is said to guide outgoing air with least possible friction and permit any degree of opening desired (or tight closed).

Swartwout Co, Cleveland 12, Ohio.



P1034 • HORIZONTAL TURBINE— Rugged, simple and practically foolproof turbine develops 500 bhp at 1750 rpm. It takes steam at 850 to 900 psi, and 850 F, and exhausts into a vacuum of 12 in. Hg, or against 2-psig backpressure.

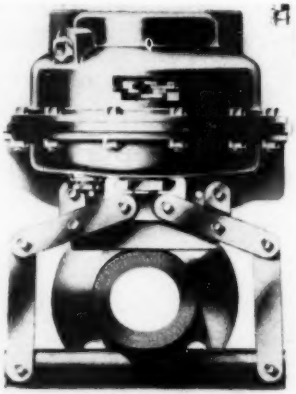
Casing is supported near center line on pedestals. Rotor is a solid one-piece wheel, 48 in. in diameter; blades are milled around periphery of a solid steel forging. The turbine is equipped with an oil-relay-actuated constant-speed governor, separate emergency governor of the poppet type, gear-driven oil pump to supply oil for governor and turbine bearings, external oil cooler, automatic backpressure trip and standard accessories.

Whiton Machine Co, New London, Conn.

P1023 • BALL-BEARING MOTOR — Air-cooled, ball-bearing motor, Type *TEFC*, polyphase, 50- or 60-cycle, constant-speed, continuous-duty, squirrel-cage induction-design, has high torque, low starting current for sizes from 2 to 60 hp.

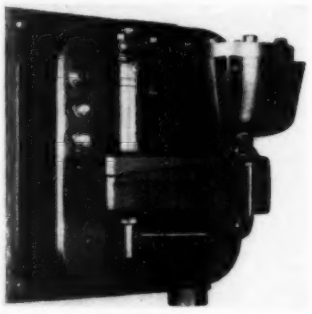
Motor housing is totally enclosed. Air enters through the external hood, passes over stator core and out over pulley bearing. Small fan blades on rotor circulate the air inside. Actual temperature rise does not exceed 55 C.

Dept 104, Valley Electric Corp, 4221 Forest Park Blvd, St. Louis 8, Mo.



P1051 • VALVE — *Slip-on* valve Type 7100, in sizes ½ to 2½ in., mounts over the ends of the pipe. The flange-end Type 7200, in sizes 1 to 12 in., and the diaphragm motor type in sizes 1 to 10 in., both operate air-to-open and air-to-close. Valve is adaptable for abrasives or corrosives not affecting the rubber, neoprene, Buna N and butyl tube.

Flexible Valve Corp, Palisades Park, N.J.



P1056 • FLOWMETER — *Hays-Penn Magna-Clutch* flowmeter has five adjustable range tubes for use on from 17 to 750-in. water differential. Working pressures are 1500 and 2500 psi.

Manufacturer claims 3.75-in. dia float and float travel of 1.5-in. gives more power and absence of a stuffing box eliminates friction of float movement. Float movement is transmitted through a pressure tight manometer by the magnetic clutch.

Hays Corp, Michigan City, Ind.

P1048 • IMPACT TOOL—Known as the *Slugger*, the size 588 impact tool is rated up to 4-in. bolt size. Tool weighs 215 lb and has a free speed of 355 rpm with 550 impacts per min. Over-all length to shoulder of anvil is 26⅝ in., side-to-center distance of the hammer case is 4 in.

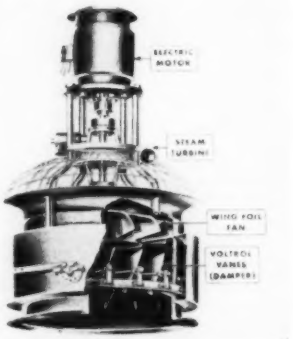
Standard equipment includes a safety air handle with independent reverse, suspension ring and dead handle.

Ingersoll-Rand Co, 11 Broadway, New York, N. Y.

P1043 • FINISHING CEMENT—Said to eliminate from three to six standard application steps, *Powerhouse* finishing cement is a dry, loose material of mineral-wool-fiber base, with a thermal efficiency approaching that of insulating cement.

For indoor or outdoor use, *Powerhouse* develops a strong, resilient surface.

Baldwin-Hill Co, 500 Breunig Ave, Trenton 2, N.J.



P1039 • DUAL-DRIVE BLOWER — Forced-draft axial-flow blower incorporates a combined electric-motor and steam-turbine drive. Change from one drive to another may be made at will.

Basic unit is Wing Type "*R*" turbine blower, with a totally enclosed, dustproof motor connected to extension of turbine shaft. Choice of drive may be governed by heat balance, more economical operating costs, or emergencies affecting source of power. To operate, simply throw the switch for electric drive or turn a couple of valves for steam drive. Wide range of control is available with both drives. Throttling gives speed control of the turbine and Wing *Voltrol* vanes permit capacity regulation for motor drive.

L J Wing Mfg Co, 50 Seventh Ave, New York 11, N.Y.

P1013 • TOTALLY ENCLOSED MOTOR—Copper fins are embedded in stator laminations for additional cooling of Type *CS*, totally enclosed, fan-cooled, squirrel-cage motors. Heat conduction from stator is handled by interleaving circular

For further data on above items use reply cards on page 186a, identifying your request with letter *P* and number

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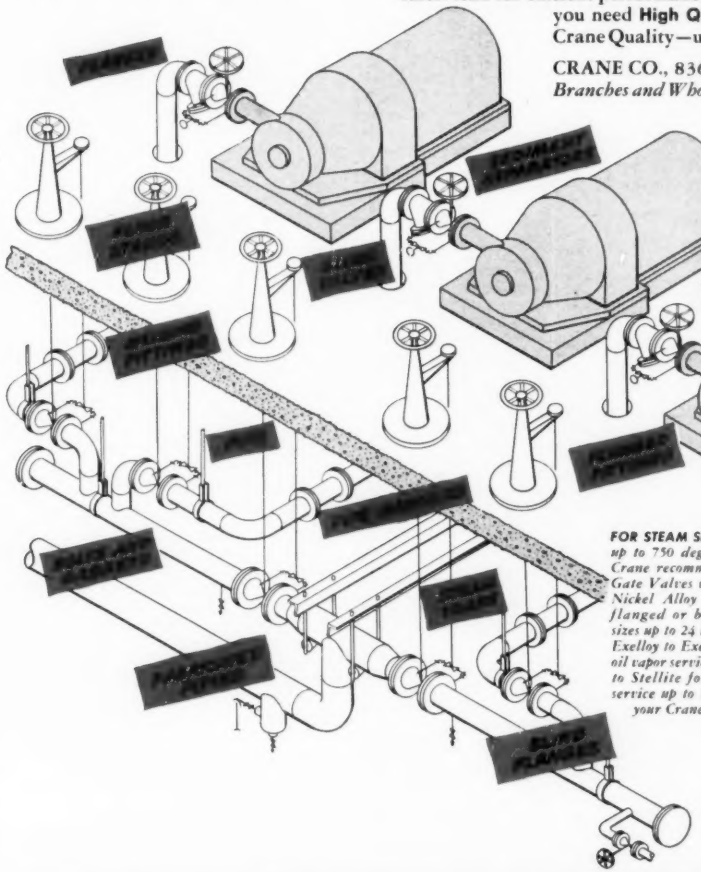

***FOR STEAM SERVICES** at 600 pounds up to 750 deg. F. temperature . . . Crane recommends No. 76XR Steel Gate Valves with Exelloy to No. 49 Nickel Alloy trim. Available with flanged or butt-welding ends in sizes up to 24 in. Also supplied with Exelloy to Exelloy trim for oil and oil vapor services, and with Stellite to Stellite for steam or water service up to 1000 deg. F. See your Crane Catalog.*

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VALVES • FITTINGS
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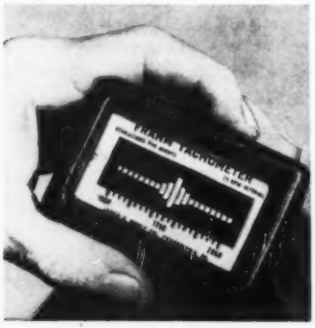
CRANE

FOR EVERY PIPING SYSTEM

copper punchings among core laminations. Fins extend beyond core iron so heat picked up can be transferred to external cooling air.

Motors are for service in central stations, cement mills, flour mills, coal-pulverizing plants, grain elevators, steel mills and other locations where atmosphere is contaminated with dust particles. Motors, which are not for outdoor use, are available up to about 1500 hp at 1800 rpm, Class B insulation, 75 C rise.

Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa.



P1006 • TACHOMETER — Resonant-reed tachometer requires no contact with rotating element and imposes no load on machine under test. Speed check is made by simply touching instrument to machine casing.

Device cannot be injured by overspeeding and requires no maintenance. Instrument is available in various ranges between 1000 and 13,000 rpm.

James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

P1037 • DIESEL ENGINE — Four-cylinder diesel with maximum rated horsepower of 110 at 1800 rpm, designated *HR*-400, is light and compact. Mounting dimensions for basic industrial model are 43 7/32x29⅜x47⅞ in.

With 5½-in. bore and 6-in. stroke, piston displacement is 495 cu in. *HR*-400 is a 4-cycle engine and uses Cummins fuel system. It is equipped with standard 2-valve heads; a new increased-flow lubricating system; continuous-groove main bearings; standard *HR* liners and head gaskets.

Cummins Engine Co, Columbus, Ind.

P1035 • LOG-LOG SLIDE RULE — A 6-in. duplex all-metal log-log slide rule, bearing regular 10-in. log-log scale arrangement, incorporates following features: (1) 16 scales (2) dimensionally stable magnesium-alloy body, with optical tongues and grooves machined to .001 in. accuracy to insure permanent alignment, freedom from distortion and easy operation (3) needle-sharp graduations on scales optically spaced for easy reading—computational accuracy is said to be comparable to 10-in. rule (4) combination *C-D* scales on both sides of rule, together with folded and reverse scales, speeds figuring and avoids going "off-scale."

An illustrated instructional manual comes with each rule. Model 300 log-log rule is 1 3/32x6x3/32 in. in size. It comes in full-leather pocket case, slip-boxed with manual.

Pickett & Eckel, Inc, 5 S Wabash, Chicago 3, Ill.

P1046 • BOURDON GAGE—*Helicoid* gage with 3½-in. dial, made with steel bourdon tube, is adaptable for ammonia-ice machines, pumps, compressors and hydraulic presses up to 10,000 psi.

Gage features *Helicoid* movement, stainless steel bearings, *Korex* steel bourdon tubes, fused joints and external pointer adjuster. Gage is also furnished in 4½-, 6- and 8½-in. dial sizes.

Helicoid Gage Div, American Chain & Cable Co, Bridgeport 2, Conn.

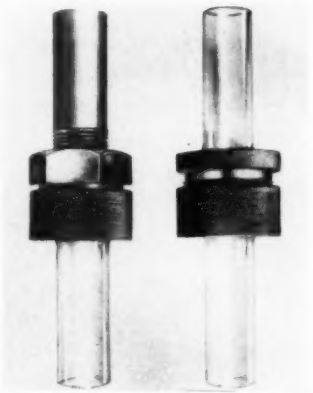
P1007 • OIL TEST KIT—Neutralization number (acidity) of transformer, turbine and other mineral oils may be checked with this kit without using technical skill. Neutralizing KOH is in sealed ampoules. Ampoules are supplied with a neutralization value of .3, .6 and 1.5 mg of KOH per gram of oil.

Use of acidity tests is well established as a quick indicator of oil deterioration. Four glass cylinders are furnished for making tests, in addition to two pints of a water-alcohol-pink indicator neutral solution and 20 ampoules of KOH.

Gerin Corporation, Red Bank, N.J.

P1041 • BLUEPRINT PRECOATER—*Mertone* blueprint paper precoater produces prints with uniform deep blue backgrounds without burning out faint lines of tracing, maker reports. Other claims include greater latitude in printing speeds, fewer changes in machine speed and less waste through over-exposure.

Monsanto Chemical Co, St. Louis 4, Mo.



P1032 • GLASS-PIPE COUPLING — Threaded metal coupling simplifies installation of glass piping by replacing 3-bolt triangular metal flanges. Use of wrenches is no longer necessary.

Makers claim perfect alignment is assured, and danger of breakage because of uneven take-up is eliminated. Installation time is reduced up to 60%. Metal couplings are available from stock in sizes ¼, ½, ¾ and 1 in. for making glass-to-glass or glass-to-metal connections.

Fischer & Porter Co, Hatboro, Pa.

P1011 • LOCKING FUSE CLIP—Fuse and resistor clip has a unique locking device that holds ferrule firmly in place. This insures an uninterrupted flow of current at all times regardless of vibration.

Clip has an ejector that makes it easy to remove fuse with a single tip of ejector spring. Device is particularly suited for service by power companies and manufacturers of electrical equipment where excess vibration may be encountered.

Advertising Dept, Raytheon Mfg Co, Waltham 54, Mass.

P1019 • INSULATING TAPE — Applied by vulcanization, *R*-12 and *R*-20 *Silastic* tape is a *Fiberglas* cloth impregnated and coated on both sides with *Silastic* rubber. On one side the rubber has been completely cured, but on the other only semi-cured so when heated for vulcanizing a solid insulation piece is formed.

From −70 to 500 F the tape retains

For further data on above items use reply cards on page 186a, identifying your request with letter P and number

MUCH ELECTRICAL MANUFACTURING MAGIC BEGINS HERE

● One of the best known manufacturers of air circuit breakers in the country is the I-T-E Circuit Breaker Company, located at 19th and Hamilton Streets in Philadelphia. From its inception the company has displayed unusual receptiveness to new ideas, whether from within or without; hence it has done its share of pioneering, and perhaps more. Revere is proud to play a part in its progress, through close collaboration with I-T-E engineers, production men, and the purchasing department. The extensive use of Revere Extruded Shapes is but one result of our mutual attack upon I-T-E problems, which the company is good enough to say has saved a great deal of money, as well as made possible a better product . . . Perhaps similar results would be obtained if you gave us the opportunity to place our knowledge as well as our metals at your disposal. Why not inquire?

REVERE

COPPER AND BRASS INCORPORATED

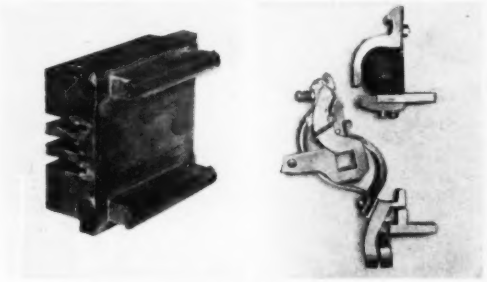
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

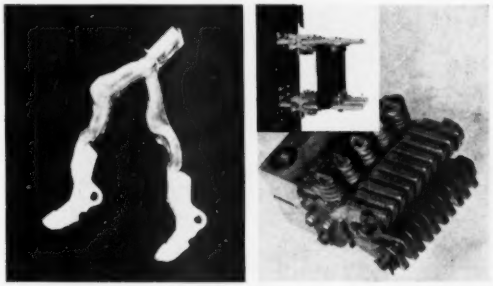
• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

This is but a part of the I-T-E Stock of Revere Extruded Shapes in copper, brass, manganese bronze, and aluminum. I-T-E is a great advocate of extruded shapes, from long experience finding them markedly superior, in uniformity, strength, and economy due to the fact that a great deal of machining is avoided.



(*Left*) I-T-E Contact Block made from an extruded shape. This was formerly extruded in electrolytic copper; changing to Revere Free-Cutting Copper resulted in a saving of 30% in machining time. (*Right*) I-T-E "K" Breaker, Main Contact Assembly in open position. This is an especially interesting assembly, since it shows no less than eight extruded shapes in copper and bronze. Use of these shapes makes the assembly more compact, stronger, lighter, and considerably more economical to produce. The contacts are silver alloy, and the unit is silver plated. . . . In addition to supplying I-T-E with extruded shapes, and strip, Revere furnishes rolls, bar, rod, sheets, in a wide range of non-ferrous alloys, and seamless brass tube.

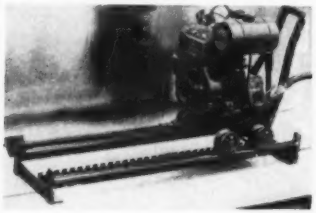


(*Left*) Main movable Contacts and Flexible Connectors in an I-T-E "K" Type Circuit Breaker. The two contacts are made from Revere Extruded Shapes. Revere and I-T-E collaborated closely on the specifications for the thin-gauge copper strip for the pigtails, working out the correct gauge and temper to avoid notch effects and cracking of the connection at the braze. (*Right*) Main Separable Contacts from an I-T-E Type "LG" Circuit Breaker. These are stamped from Revere Copper Strip with the temper specially controlled to eliminate a de-burring operation previously found necessary to obtain edge surface suitable for electrical contacts. (*Inset*) Back view of "K" type Breaker showing a similar type of contact.

EQUIPMENT NEWS *CONTINUED*

physical, chemical and dielectric properties. It has a dielectric strength of 450 v per mil. The tape vulcanizes at 260 F in 15 min. After vulcanization give the tape an after-cure in an air-circulating oven at 400 F for a period up to 4 hr, depending on the thickness.

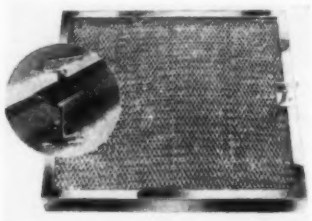
Irvington Varnish & Insulator Co, Irvington 11, N.J.



P1055 • BORING MACHINE — *Earthworm* boring machines now permit laying of pipelines of all types up to 3 in. in dia and up to 150 ft in length without breaking ground surface.

It is ideal for laying lines under highways and other sites where surface excavations would be costly and inconvenient. Drilling can be maintained within 1 in. of the target area.

Lube Jack Co, 1415 - 14th St, Santa Monica, Calif.



P1050 • FILTER LOCK—The handle lock is designed for installation on *R-P Alumaloy* grease and industrial air filters. Lock provides rattle-free fastening automatically with a helical spring.

Once assembled, a quarter turn of the handle in either direction moves the latch rod over a built-in cam, which lifts the rod to clear any commonly encountered holding frame flange.

Research Products Corp, Madison 10, Wis.

P1022 • COAL SIZER—Self-contained lump-coal reduction unit, the Eagle *Coal Cracker*, turns out 30-50 tons of small egg or nut coal per hr handling lumps up to 10 in.

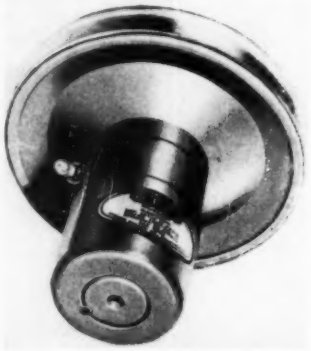
Toothed dual rolls are so tensioned and teeth so shaped and meshed that a minimum of fines result. Rolls are semi-steel with deeply chilled teeth to resist wear. Unit has a V-belt drive from either a 10- or 15-hp, 220-440 v ac motor. Gears may be selected for either ⅜ to 1⅝ or 1⅜ to 2¾ in. reduction.

Eagle Iron Works, Des Moines, Iowa.

P1025 • CONTINUOUS BLOWDOWN—Packet type, continuous blowdown, designed for small plants under 20,000 lb per hr steaming capacity, gives automatic control of boiler-water concentration.

Simple control establishes the amount of continuous blowdown in proportion to the quantity of makeup water and its impurities. Heat from the blowdown water is absorbed in a heat exchanger and returned to the boiler cycle.

Henszey Co, Watertown, Wis.



P1030 • VARIABLE-SPEED UNIT—Designed for accurate and dependable variable-speed control of light machinery without stopping the machine, *Vari-Speed Jr* is a unit assembly. It comprises a self-adjusting V-type pulley that may be mounted on shaft of constant-speed motor and V-belt connected to driven machine.

As motor is moved back on sliding or pivoting base, V-belt rides on a smaller diameter in the expanding pulley, and speed delivered to machine is decreased. As motor is moved forward, pulley contracts under spring tension, belt rides at a greater diameter and speed is increased.

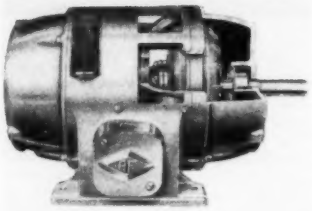
Vari-Speed Jr is made in six sizes for service with any standard constant-speed motor up to 1½ hp and any A or B V-belt. Unit delivers variable speed between 1¾ to 2¾:1. Company furnishes tables for selecting correct size unit and driven pulley for desired speed range with given motor.

Reeves Pulley Co, Columbus, Ind.

P1021 • WELDING ELECTRODE — New electrode, All-State No. 299, combines resistance to corrosion with a tensile strength of 110,000-120,000 p-i, as welded. Electrode has turned in a good performance on the special, high chromium-nickel steels, as well as high alloy, tool and die steels.

Base metal is preheated to a temperature of 300-500 F for best results. Material is recommended for vanadium-moly spring steel, nickel-clad, medium-carbon and air-hardenable steels.

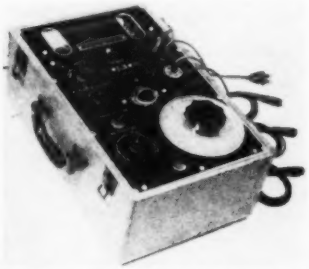
All-State Welding Alloys Co, 273 Ferris Ave, White Plains, N.Y.



P1002 • FLUID-SHAFT MOTOR — New units integrate motor and fluid-drive coupling in a single frame. These motors offer many advantages where loads require smooth acceleration, protection from jamming and shocks or are difficult to start, such as conveyors, extractors, bridge and trolley drives on cranes, winders and mixers.

Since motor is practically up to speed before any load is applied there is no need for over-motoring. Units are available in ½-, ¾-, 1-, 1½-, 2-, 3-, 5-, 7½-, and 10-hp sizes. They are also supplied in combination with reducers in single or double reduction types.

Reuland Electric Co, Alhambra, Calif.



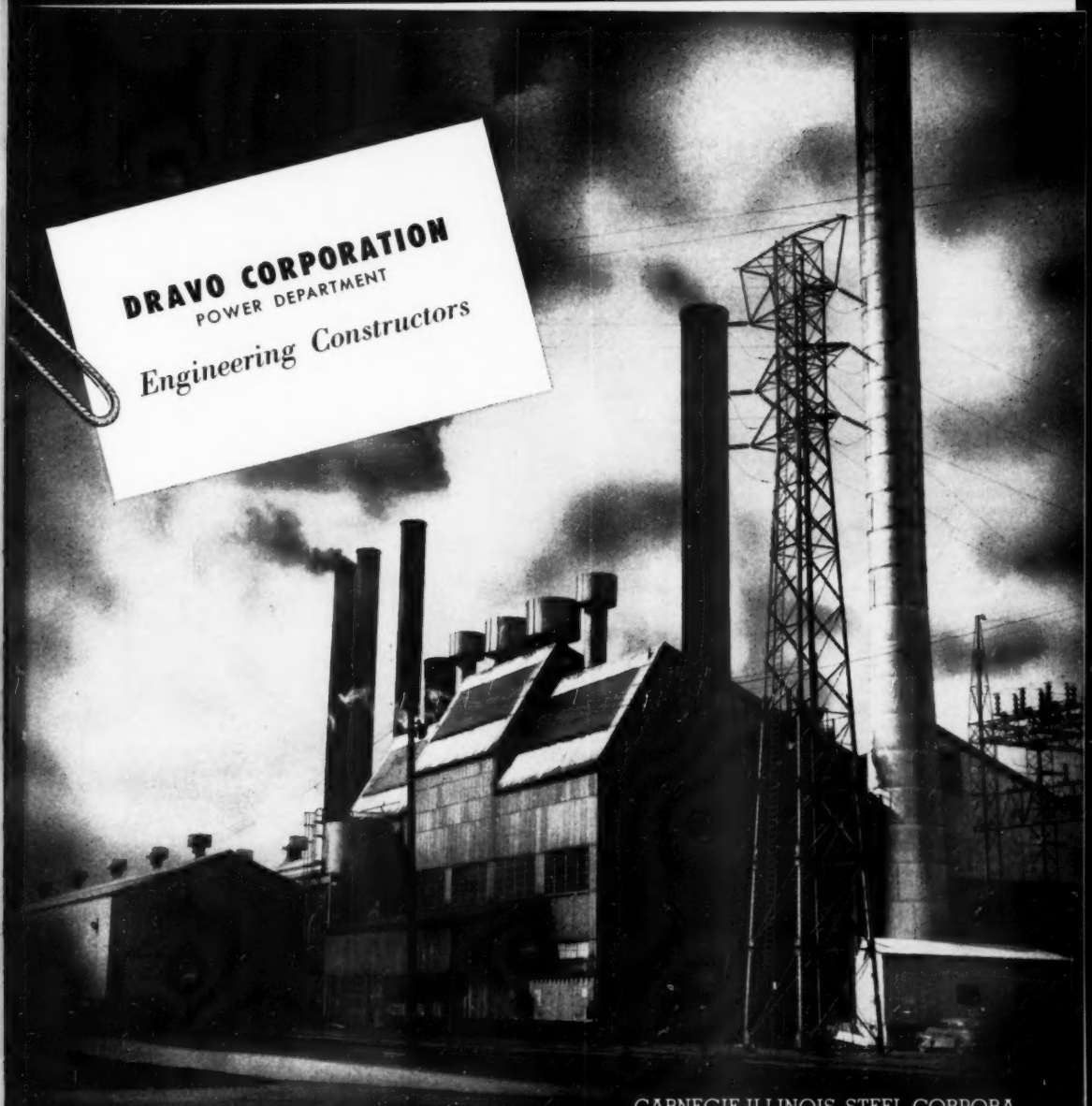
P1004 • WHEATSTONE BRIDGE — Electronic *Resistohmeter* measures resistance and insulation resistance in low and extremely high ranges. A 6*E*5 electron-ray tube replaces the usual galvanometer.

Instrument is guarded internally so leakage across the bridge components, because of high humidity, does not affect bridge accuracy. Device has a range from 1000 ohms to 100,000 megohms. Three test voltages are used: 10, 100 and 500 dc.

Crown Industrial Products Co, 1309 W 69th St, Chicago, Ill.

(Continued on page 142)

For further data on above items use reply cards on page 186a, identifying your request with letter *P* and number



CARNEGIE-ILLINOIS STEEL CORPORATION'S Irvin Works is one of the largest, most modern finishing mills in the nation. Its Boiler Plant was originally constructed and has been progressively modernized by Dravo Corporation. The latest extension, a complete, new boiler facility, is but one of ten major power projects currently being constructed by Dravo.

DRAVO
CORPORATION

DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations. Fabricators and erectors of power piping. Machinery installation. Power and boiler plant equipment.

PITTSBURGH · PHILADELPHIA · CLEVELAND · NEW YORK · DETROIT

EQUIPMENT NEWS *CONTINUED*

P1024 • FURNACE WALLS — Suspended furnace-wall enclosures, used with or without a steel casing, are universal in application for both furnace areas and convection sections of boiler.

Wall can be so insulated that face temperature is reduced to about 20 deg above ambient. Downcomers or feeder tubes can be concealed within the wall insulation. All refractory shapes are of a modular design, refractory thicknesses being 3 and 4½ in.

George P Reintjes Co, 2517-19 Jefferson St, Kansas City, Mo.

P1018 • WELDING ELECTRODE — No-gap, ac-dc *Eutec-Hand-Omatic* electrode is merely pressed against a light gage metal and drawn straight along like a pencil without weaving back and forth to give a perfect weld automatically.

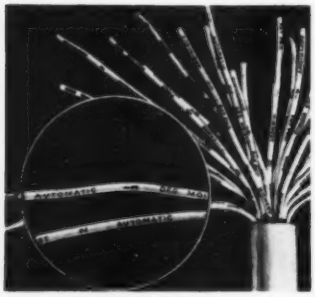
Electrode gives excellent results with mild steels, low alloys, high tensile steels of light gage. It needs no special equipment. Weld has a tensile strength of 70,000 to 80,000 psi. It is available as No. I in 3/32, ⅛ and 5/32 in. dia; No. II and No. III in ⅛ and 5/32 in. dia.

Eutectic Welding Alloys Corp, 40 Worth St, New York 13, N.Y.

P1020 • TERMINAL BLOCKS—Solderless type *Bepco* molded terminal block eliminates need for wrapping wires around studs or using separate terminals as wire ends. Blocks have compression type solderless units to handle wires from No. 16 to 6 AWG.

Typical are wire combinations accommodated by a single terminal using two No. 10, two No. 12 or two No. 14; one No. 12 with one No. 10, one No. 12 with one No. 14, etc. Units, rated at 35 amp, 600v, are available in 4, 8 and 12 circuit sizes.

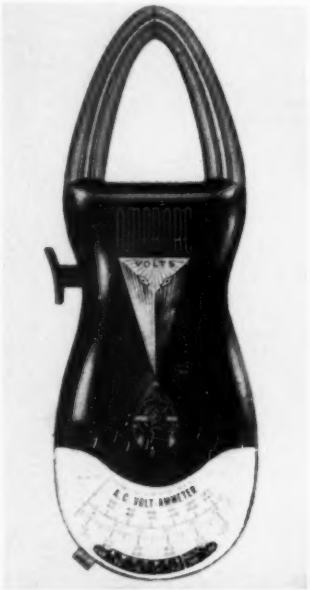
Buchanan Electrical Products Corp, 1290 Central Ave, Hillside, N.J.



P1016 • CODED WIRE—Numbers are used instead of color-coding to increase ease and accuracy of installation and maintenance. Each wire has its code number imprinted in bright red on every inch of the yellow insulation.

Numerals do not wash or wear off nor become discolored with age. There is no limit on number of different numerals available. This wire is especially useful for automatic control systems, printing presses, signal devices, elevators and other equipment using multiple-wire electric controls.

Midwest Automatic Control Co, 510 Third St, Des Moines, Iowa.



P1008 • SPLIT-CORE METER — Trigger opens transformer probes and clamps around conductor to measure circuit current. To measure voltage, a pair of test leads are inserted into front-mounted pin-jacks and connected to line.

Designed as a rugged pocket instrument for electrician, motor repair and maintenance men, the *Amprobe* is 7⅛ in. long, 2 9/16 in. wide and 1⅛ in. thick. Instrument is available in two models: Model *A*-5 handles between 6.5 and 130 amp and 130/260 v; Model *A*-6 rated for 10 to 250 amp and 150/600 v.

Pyramid Instrument Co, 49 Howard St, New York, N.Y.

P1009 • DRY LUBRICANT — *Molykote* is a molybdenum-disulphide powder, similar in appearance to graphite, though it contains none. It will prevent galling and seizing at bearing pressures well over 100,000 psi at either high or low sliding velocities.

Lubricant is easily applied with a cloth or fingers. With light rubbing it adheres firmly to even smoothest surfaces. Ten ounces cover 500 sq feet of smooth metal with a tenacious shiny coating. *Molykote* is suggested for use as a factory-applied lifetime lubricant for some mechanical devices.

Alpha Corp, Greenwich, Conn.

P1014 • HYDRAULIC DYNAMOMETER—Designed for load-testing large electric motors, the *SA*-484 dynamometer has a capacity between 30 and 300 ft lb. Unit is placed directly on test floor and is provided with jack screws for raising to correct height for connection to motor to be tested.

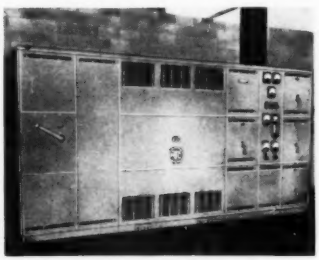
Adapters for 1⅛-, 1¼-, 1⅜-, 1⅞-, 2⅛-, 2⅜-, 2⅝- and 2⅞-in. motor shafts are furnished with each unit. Dynamometer tests include idle, pull-in, pull-up, full-load and locked rotor. The dynamometer cannot be used for a motor heat-run test.

Wagner Electric Corp, 6400 Plymouth Ave, St. Louis 14, Mo.

P1057 • RECORDER PEN—Solenoid-actuated pen that provides speedy recording and avoids ink-throwng has been developed for circular chart electronic potentiometers.

Pen makes use of an amplifyng linkage designed so the solenoid's high velocity reaction is almost spent before the pen is picked up and moved. Pen holds a 5-day supply of ink. Manufacturer says the new device is essential for thermal limit recording in continuous pasteurizing processes.

Brown Instruments Div, Minneapolis-Honeywell Regulator Co, Philadephia, Pa.



P1010 • UNIT-SUBSTATION — Complete power package consists of a dry-type transformer, primary protection, as well as secondary breakers and necessary metering equipment. Transformer section is constructed throughout with Class B and C heatproof insulation, such as *Fiberglas*, mica, porcelain, or *Quinterra*.

Absence of oil or toxic liquid is a safety feature that makes equipment suitable for installation in hospitals, schools, hotels and industrial plants. Units are available in sizes from 100 to 2000 kva inclusive, both single- and 3-phase, in voltages up to 15,000.

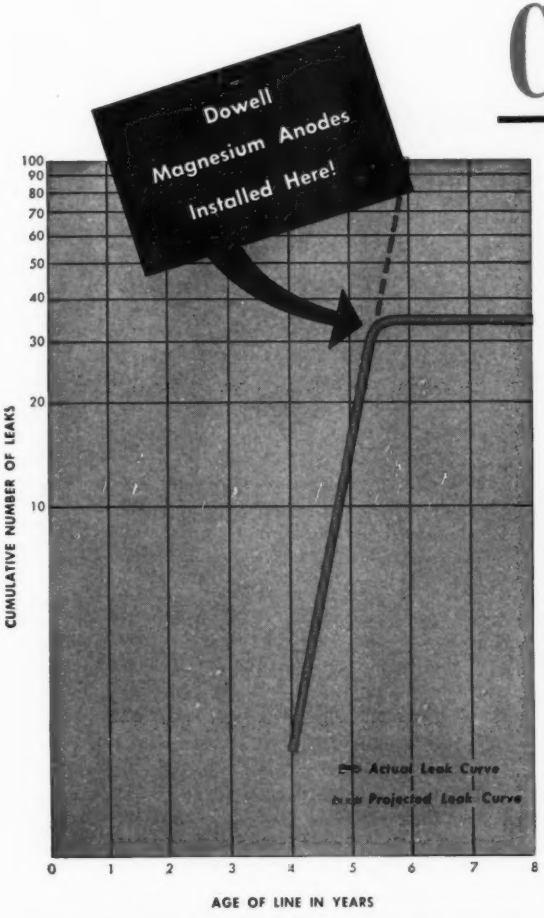
Marcus Transformer Co, 32-34 Montgomery St, Hillside 5, N.J.

(Continued on page 166)

For further data on above items use reply cards on page 186a, identifying your request with letter P and number

Here's How . . .

PIPELINE MAINTENANCE COSTS CAN BE CUT!



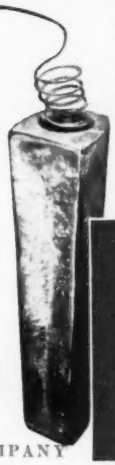
One way to lower pipeline maintenance costs is to reduce the number of leaks. The graph at left shows how a Gulf Coast city cut leaks in a 27 block, 2″ galvanized piping system. The system was installed in 1940 and 1941. By April, 1946, leaks were appearing at an accelerated rate. *Then, magnesium anodes were installed!* Result: 2 leaks in the 30 days following installation and *no new leaks for the balance of 1946, 1947 and 1948!*

Cost-cutting protection such as this is being achieved with Dowell magnesium anodes. When corrosion of buried metal structures is a problem . . . for example, on oil and gas pipelines or municipal distribution systems . . . Dowell anodes may afford practical, economical corrosion control. The degree of protection will depend on soil conditions and the number of anodes used. Dowell magnesium anodes require no external power and maintenance is at a minimum.

Dowell anodes are carefully alloyed to specifications designed for peak efficiency and long life. The development of these anodes was pioneered by The Dow Chemical Company. Now, Dowell . . . a Dow Subsidiary . . . is carrying on the marketing, research and further development of magnesium anodes. Dowell can give you the technical advice to make your anode installation effective and economical. Write to Dowell for a new book containing detailed information on the uses and installation of Dowell Magnesium Anodes.

DOWELL INCORPORATED
TULSA 3, OKLAHOMA

FREE SHOWING! Now available—a new 18-minute sound slide film illustrating the possibilities of Dowell magnesium anodes for corrosion control. A Dowell representative will gladly arrange a special showing at your plant, office or organization meeting. Call or write Dowell.



DOWELL

MAGNESIUM ANODES

GALVO-PAK • GALVO-LINE

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Meet Jim Henderson, Engineer

I saw Jim Henderson yesterday for the first time in 20 years. We used to work the same shift back in St. Louis.

Right now he's chief power engineer for a shoe factory in Pennsylvania. He'd brought his wife to New York for a vacation, and while she was spending his hard-earned money in Fifth Avenue department stores, we renewed our friendship. One thing led to another until . . .

"Jim, you sure are lucky to be enjoying yourself here in the big city without a worry in the world. I know many chief engineers who always spend their vacations close to home in case something goes wrong. How do you do it?"

"It's very simple, George. A long time ago I decided that running the plant is only part of a chief engineer's job. Actually he's got more important things to do. Only where to find the time to do them?

"That part of it was easy and a lot of fun. I figured that if any of the men under me were ever to become chief engineers themselves, they might as well start getting the experience right away.

"Here's how I went about it. Instead of just telling them how to do a job, I'd tell them why, too. Then I moved my engineering books and magazines out of the office into the plant where the men could get at them. I even suggested certain articles for them to read on problems similar to ours. They did and would debate controversial points for days afterwards—each man learning from the other.

"Then I closed my eyes and crossed my fingers. I relaxed my watch over the men and let each man do his job his own way. Sure they made mistakes. Fortunately, they made no serious blunders. Of course, I knew they knew enough not to do anything really foolish.

"Point is I purposely let them make mistakes because they can be a man's best lessons. That's if the chief doesn't make a mistake himself by climbing all over the fellow. That would only spoil the lesson and make the man feel inferior.

"All this paid off in a very short time. When I first let the men go their own way, they were cautious and bothered me a lot about little problems. But soon they learned to make their own decisions and enjoyed it. Finally the plant ran smoother than when I made all decisions. And I had the time to do those other things I felt were part of my job as chief engineer."

What does a chief engineer do beside running the plant? We'll hear more from Jim later on.

George Edwards

Engineer

IN 14 YEARS NO STUCK RINGS*

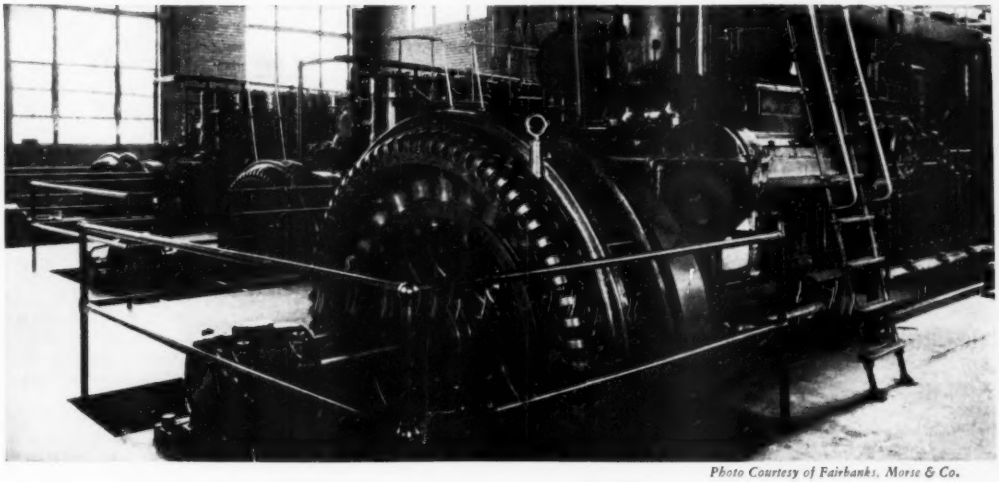


Photo Courtesy of Fairbanks, Morse & Co.

Diesels lubricated with Texaco *stay clean—cost less to operate*

THE case illustrated is typical. Operators everywhere find that *Texaco Ursa Oils* give them year-in-year-out high Diesel efficiency... lower maintenance costs ... reduction in fuel consumption.

Texaco Ursa Oils are especially made for Diesel lubrication. That means superior resistance to oxidation ... ability to stand up under high temperatures ... freedom from carbon, sludge and varnish. *Texaco Ursa Oils* assure better compression and combustion ... longer life for bearings, pistons, rings and cylinder liners.

There is a complete line of *Texaco Ursa Oils.* Leading Diesel engine manufacturers approve them, and—

More stationary Diesel hp. in the U. S. is lubricated with Texaco Ursa Oils than with any other brand.

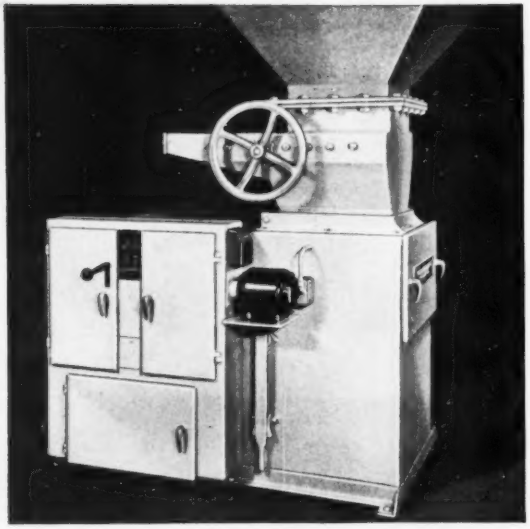
Boost the operating efficiency and economy of your Diesels. A Texaco Lubrication Engineer will gladly help you. Just call the nearest of the more than 2300 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

**Name of this Texaco user on request*

TEXACO

TEXACO Ursa Oils

FOR ALL DIESEL ENGINES

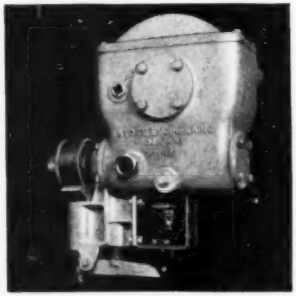


HUSKY GEARS AND BEARINGS ASSURE LONG LIFE

# of S-E-CO. COAL SCALES

S-E-Co. Coal Scales are designed with the idea that the gears and bearings of each scale will last as long as the boilers to which coal is being fed. Experience with these items over a 10-year period indicates that the design calculations are correct. To date no gear has ever worn out on a S-E-Co. Coal Scale.

If you want a coal scale which will have long life with a minimum of maintenance, investigate the S-E-Co. Coal Scale.



Start today by writing for a bulletin.

STOCK ENGINEERING COMPANY
715P Hanna Building ★ Cleveland 15, Ohio

Technical Briefs

(Continued from page 126)

craft heat-exchanger. Weight, volume, and shape of the exchanger take on considerable importance. The aircraft engine differs in that its small size requires a reduced size of ducting, which means higher pressure losses. So the thermal-efficiency improvement produced by a heat exchanger on an airplane has to be of appreciable magnitude.

This paper shows by specific examples some problems involved. It gives for two hypothetical engines a general idea of size and weights of exchanger cores necessary for the attainment of various engine thermal efficiencies. *ASME Paper No.* 49-SA-18.

ELECTRICITY

WHEN SHOULD A GENERATOR BE REWOUND? *by E A Crellin, Pacific Gas & Electric Co.* One of the most indeterminate factors faced by the operating engineer is the condition of the insulation in his electrical equipment. Ultimate strength of any given piece of insulation can be determined by a breakdown test, but obviously equipment in service can't be put to such a test. There does not appear to be any completely reliable method to indicate the present condition of a generator winding or its progressive deterioration to the point where failure is imminent and replacement indicated.

Individual units differ so widely in their history in service that it is not possible to apply any role based on longevity. Final determination that replacement is necessary must rest on the operating record of the unit and the judgment of the man most familiar with its history and probable future behavior.

In answer to the question, "When should generator windings be replaced?" one conservative policy is to let sleeping dogs lie. In the 57 hydro plants on the Pacific Gas and Electric Co system there are a total of 118 generators installed. Ages vary from 54 years to less than one. Voltages vary from 500 to 13,800 v. Unit capacities run from 312 kva to 40,000.

Many units have a clean bill of health—free from insulation failures. There is no way of telling how much longer they will operate troublefree. One thing is sure. When these old generators break down it will be impossible to make a repair and feel confident that the rest of the winding is in safe operating condition. *AIEE Paper No.* 49-203.

EQUIVALENT CIRCUITS FOR POWER FLOW STUDIES, *by J B Ward, Purdue University.* Present-day extensive inter-

Here's a rugged, small gate valve you can repack right while it's in use . . . no pressure is transmitted to the stem. Use it in exposed locations, too, for a forged steel packing gland protects the vital yoke threads against rust and corrosion. A recent design feature gives stem and wedge gate connection a more than 50% increase in strength . . . extra protection against even the most extreme operating conditions.

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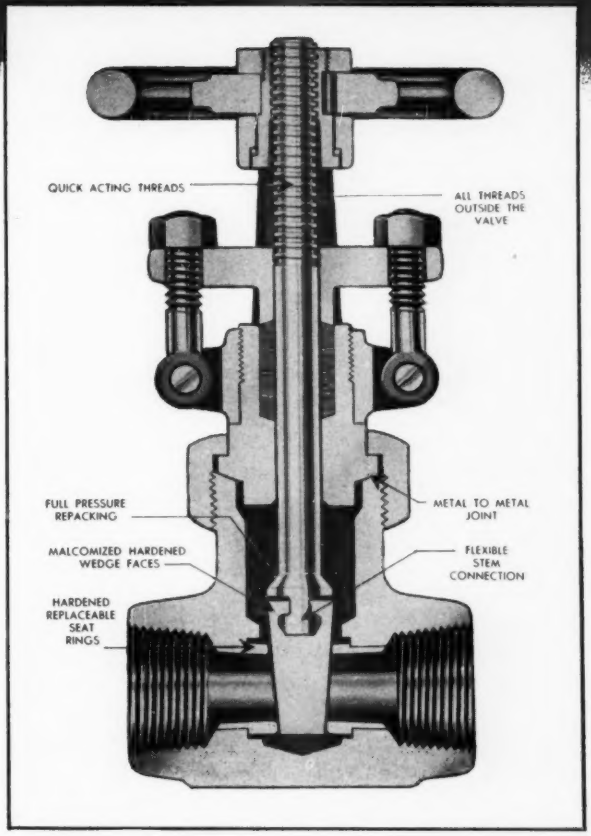

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connection between power systems complicates the analysis of steady-state network performance in the study of planning and operating problems. This complication of analysis is increasing with system expansion and additional interconnections. Network analyzer studies of power-flow conditions on large systems frequently require preliminary simplification and reduction of network. This is so because there are limitations to the number of analyzer circuits and generators available.

In studies for determining distribution of power flow over the lines of a system under various emergency conditions interconnections have an important effect, particularly if two or more ties form parallel paths through the adjoining system. Total interchange of power between separate companies is usually established by interchange contracts, but to determine the proper division of this flow over several tielines under various operating conditions it may be necessary to set up the adjoining system or an equivalent circuit representative of it. *AIEE Paper No. 49-96.*

ELECTRONICS

(Continued from page 113)

The tube is nonconductive until the grid bias is reduced below a critical value. Then it instantly conducts almost as if the grid did not exist. Thyratrons can handle much larger currents than vacuum tubes and, therefore, can power heavier relays.

Relay in Fig. 5 is designed for connection to either a 115- or a 230-v line, the only transformer used being for low-voltage cathode-heating current. When the line has the polarity shown, capacitor C_1 is charged by grid rectification. This circuit is from – line through R_4, the cathode and grid, R, C_1, part of potentiometer P, resistor R_2 to + line.

A circuit also exists from – line through R_3, potentiometer P and R_2 to the + line. Consequently, capacitor C_1 is charged as indicated to the voltage existing between – line and the potentiometer arm. Potentiometer P adjusts the voltage to which capacitor C_1 is charged. Therefore the relay's time delay can be adjusted as in Fig. 3. Moving the arm on P all the way to the left increases the charging voltage to the maximum and likewise the time delay. Moving the arm fully to the right gives minimum charging voltage and time delay.

Thyratron Grid Current. Once a thyratron becomes conductive the grid current may increase to a harmful value unless prevented by resistor R. This resistor is selected to limit grid current to a safe value. Its resistance varies for

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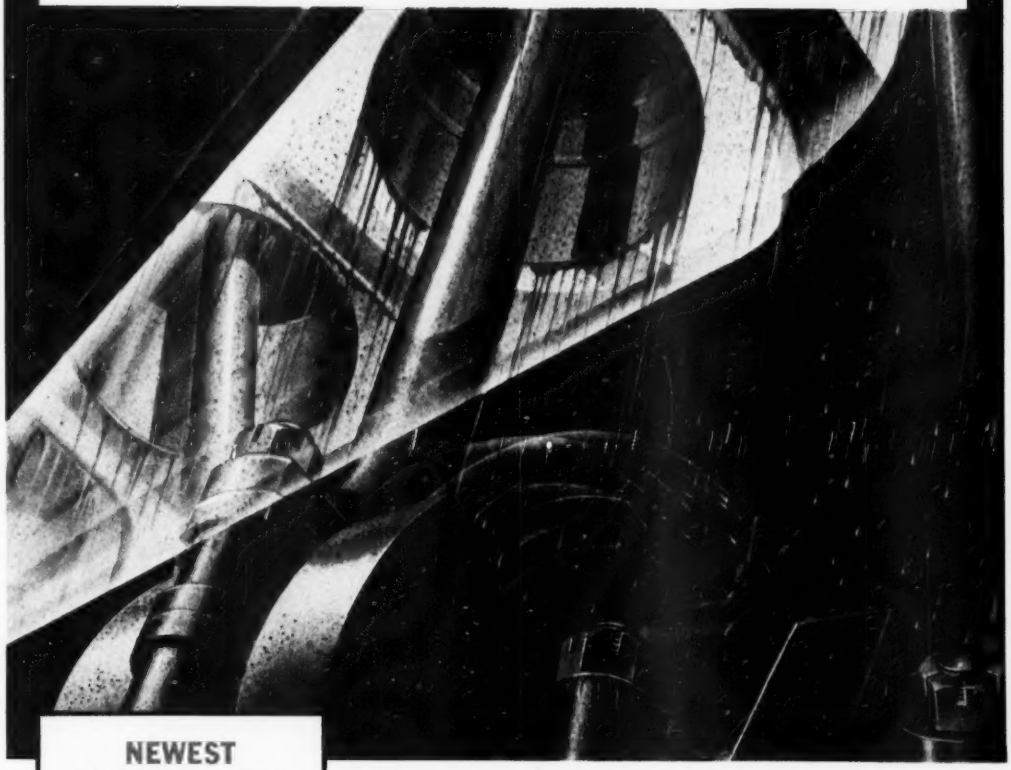

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Adjustable for 0 to 2500 lbs. W.S.P. Dial scale is illuminated. Low, Normal, and High markings as well as the pointer are phosphorescent so that they may be read in the dark in case of power interruption. It will pay you to investigate this top efficiency gage with the *extra* features.

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different thyratrons, but 100,000 ohms is a common value.

Capacitor C_2 is something we did not have in the other circuits. This capacitor has a low rating from 0.001 to 0.005 microfarads. It tends to maintain proper anode-grid-cathode voltage distribution to prevent the tube conducting accidentally. This capacitor is charged to the voltage drop from cathode to grid, which is low.

Shield Grid. The shield grid also assists the control grid in keeping control of the tube until the correct instant for it to conduct. This grid is between the control grid and the anode and the cathode. It is so located that the control grid cannot readily have cathode material deposited on its surface, nor can it absorb heat from the cathode, anode or the arc stream. By protecting the control grid in this way it has accurate control of the tube over a wide range of conditions.

When the line polarity reverses, capacitor C_1 slowly discharges through R_5. It also tends to discharge through R, from the control grid to the cathode, R_3, R_2, part of P back to C_1, to maintain a minus bias sufficient to prevent the tube conducting.

Closing switch D, Fig. 6, connects the cathode directly to the − line. The control grid, through R_2, part of P, R_3 and R, also connects to the same line. This permits the grid and cathode to come to the same potential. But capacitor C_1 discharges through R_3 and tends to discharge from the control grid to the cathode. It maintains this grid at a minus potential.

Grid Bias Decreases. As the capacitor discharges the potential of the control grid decreases, until it drops below the critical value when the tube suddenly conducts to close the relay. As previously explained, the time required for the relay to close after D closes depends on the setting of potentiometer P and the resistance of R_5. Once closed, the relay remains so until D is opened when it drops out almost immediately.

Resistor R_4, besides helping to limit the current flow to the control grid during rectification, also permits D to connect the cathode directly to the left-hand line. In Fig. 6 current flows through D and R_4 to the + line as well as through the tube and relay.

When the polarity reverses as in Fig. 5 current flow is from the right-hand line through R_4 and D to the left-hand line. Switch D then shunts out the grid circuit so there cannot be any grid rectification. Capacitor C_1 remains discharged and the control grid at zero potential. It is only when switch D is opened that the grid again gets control of the tube as in Fig. 5.

Time-Delay Reset. Fig. 7 is for a relay that is not ordinarily considered

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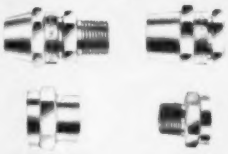

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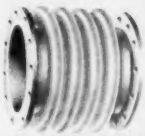

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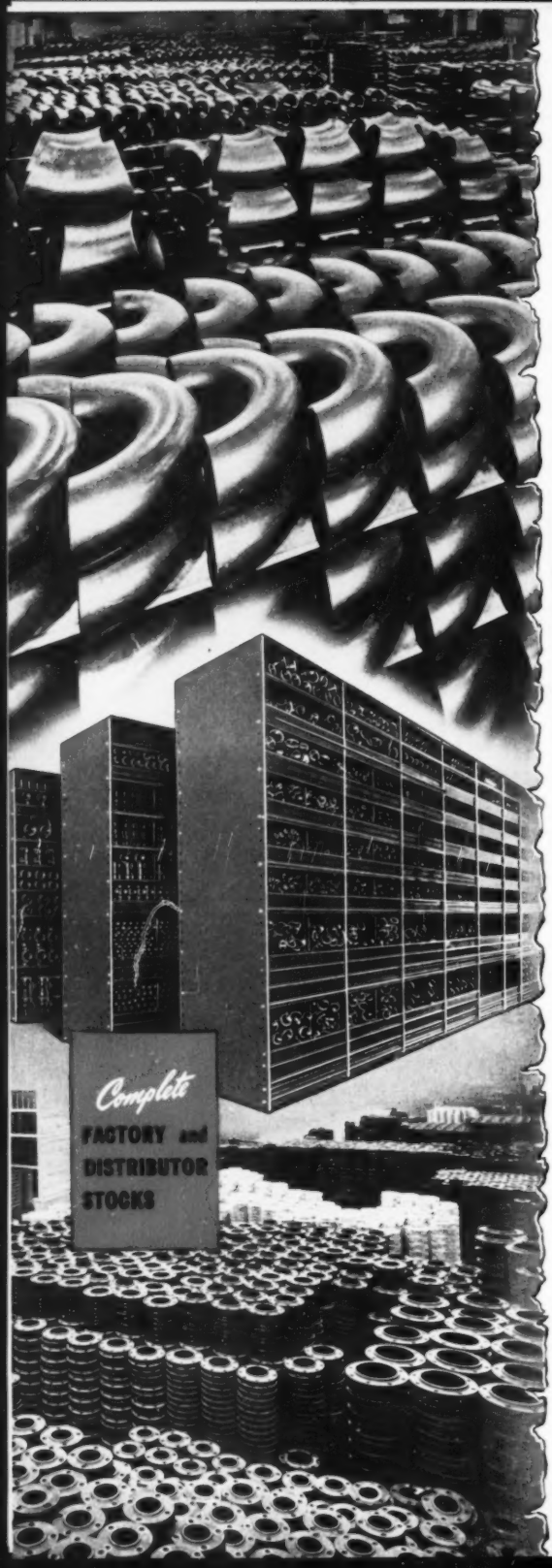

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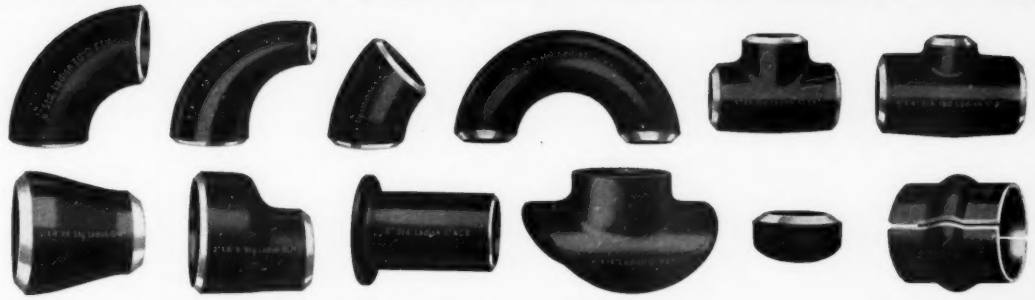

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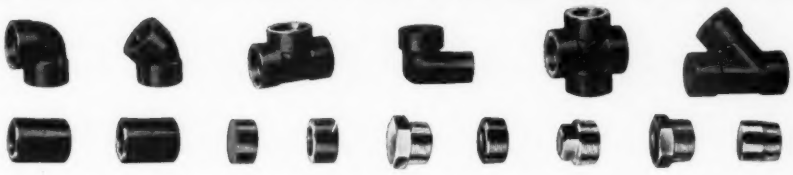

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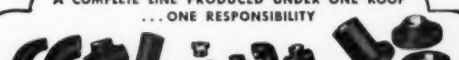

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TURBINE TIPS

no. 3

question: Are turbines a good choice in locations where conditions are tough—corrosive atmospheres, exposure to water, grit, and so on?

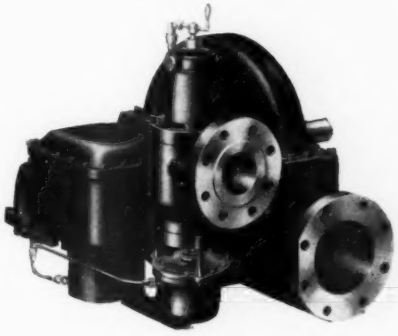
answer:

Yes, if the design provides proper enclosure and protection of vital parts—particularly the governor. Parts that are particularly prone to corrosion should be made of corrosion-resistant material. Turbines may be used with safety even in explosive atmospheres providing a nonsparking trip mechanism is used.

question: What standard turbine is a good choice in such locations?

answer:

We recommend the standard DP turbine—here's why: the governor can be relied upon regardless of where the unit is installed—since the governor is *completely* enclosed in an oil atmosphere, is never exposed to the atmosphere. All external springs are cadmium plated to prevent rust—a standard feature. The DP is safe in explosive atmospheres—nonsparking trip mechanism is standard. Even in locations where no cooling water is available, the DP can be used with a special air-cooled oil cooler.



question: Where can I "get the facts" when considering a turbine application?

answer:

Just call or write the nearest G-E Apparatus Sales Office. Your G-E sales Engineer will gladly give you complete data on the application of turbines to your mechanical-drives—regardless of location. Apparatus Department General Electric Company, Schenectady 5, N.Y.

GENERAL ELECTRIC

252-41

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a time-delay type. It has built into it a time-delay reset of about ½ sec for an actuating contact D resistance of 100,000 ohms. This eliminates too rapid relay operation caused by bouncing of contact D.

For example, if contact D closed and immediately bounced open, the relay would open and remain open for about ½ sec. If contact D reclosed within this time the relay would remain open. The relay responds to an actuating contact closed time as short as 0.004 sec.

This relay uses a dual-element tube. Its left-hand side acts as a half-wave rectifier to control the relay through the right-hand side, which has a control grid. The left-hand side of the tube has a suppressor grid. This serves only to improve the performance of this side of the tube, and does not influence the external circuits.

Assume actuating contact D open, Fig. 7, and the transformer polarity shown. The left-hand side of the tube conducts from S_2 to the cathode, anode, resistor R, capacitor C_2 to S_3. Capacitor C_2 acts as a very low resistance across the tube so resistor R of about 5000 ohms is connected in circuit to prevent overloading the tube.

Resistor R_1 has a very high resistance, 15 megohms, which permits capacitor C_2 to be charged to nearly transformer S_2S_3 voltage. This voltage has no effect on the grid because it connects through resistor R_2 and capacitor C_1 to the cathode, giving them all the same potential, and the right-hand side of the tube conducts. This circuit is from S to the cathode, anode, and the relay coil to S_1, and the relay closes.

Polarity Reversed. When transformer polarity reverses the tube does not conduct, but capacitor C in combination with the relay coil acts as a filter. The filter action maintains a current through the coil to hold the relay contact closed until the next conducting half cycle.

Capacitor C_2 also tries to discharge through resistor R_1 but its resistance is so high that the capacitor loses very little charge. As a result this capacitor remains charged practically all the time that switch D is open. Therefore, the capacitor is available to give the grid a minus bias the instant that contact D closes, Fig. 8.

This potential is applied from − on C_2 through R_3 to the grid, the cathode to + on C_2. Capacitor C_1 is also charged to the polarity shown to help maintain a minus bias on the grid. This action occurs no matter at what part of the cycle contact D closes. So almost instantly the right-hand side of the tube is blocked and the relay opens.

After D closed, if it bounced open, C_1 would have sufficient charge to main-

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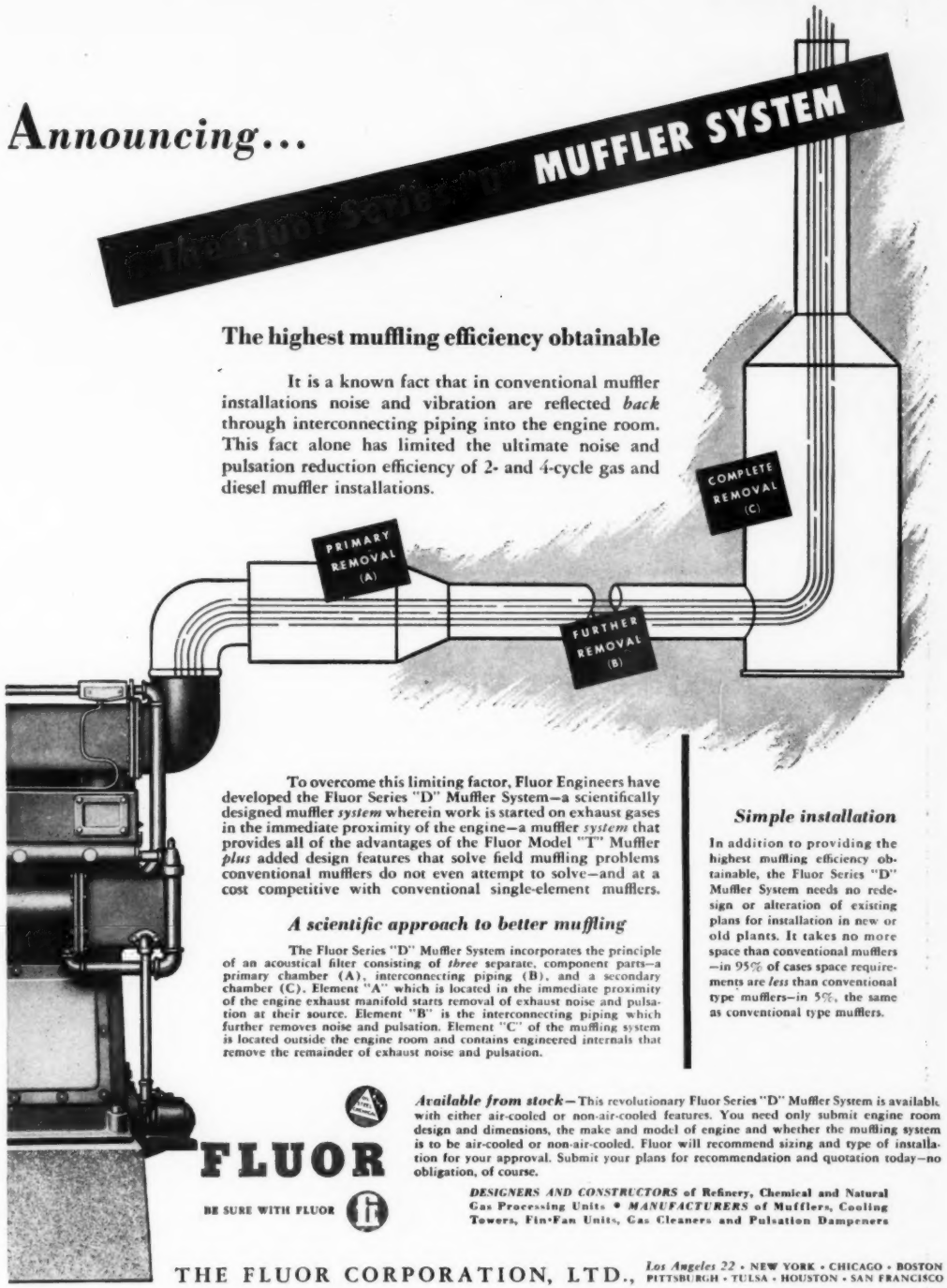
It is a known fact that in conventional muffler installations noise and vibration are reflected *back* through interconnecting piping into the engine room. This fact alone has limited the ultimate noise and pulsation reduction efficiency of 2- and 4-cycle gas and diesel muffler installations.



To overcome this limiting factor, Fluor Engineers have developed the Fluor Series "D" Muffler System—a scientifically designed muffler *system* wherein work is started on exhaust gases in the immediate proximity of the engine—a muffler *system* that provides all of the advantages of the Fluor Model "T" Muffler *plus* added design features that solve field muffling problems conventional mufflers do not even attempt to solve—and at a cost competitive with conventional single-element mufflers.

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Simple installation

In addition to providing the highest muffling efficiency obtainable, the Fluor Series "D" Muffler System needs no redesign or alteration of existing plans for installation in new or old plants. It takes no more space than conventional mufflers—in 95% of cases space requirements are *less* than conventional type mufflers—in 5%, the same as conventional type mufflers.

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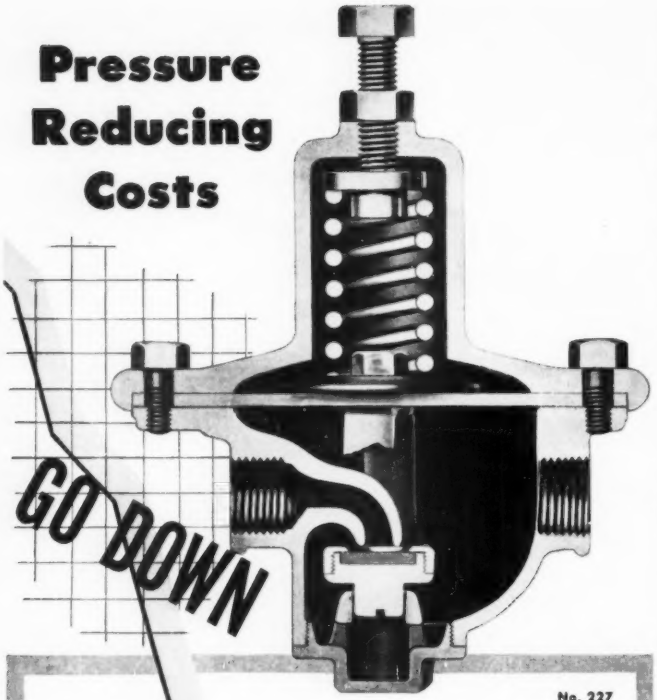

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tain minus bias on the grid to hold the relay open.

When the transformer has the polarity shown the left-hand side of the tube conducts and charges capacitor C_3 to the same polarity. A very small current flows through R_1 as in Fig. 7. Also, current flows through R_3 and R_2 in series and C_1 is charged as shown.

When transformer polarity reverses, capacitor C_1 and C_2 discharge to maintain the grid minus. C_1 discharges from its − to + terminal through R_3. C_2 discharges through D, resistors R_3 and R_2 in series back to its plus terminal. They also apply their potential from the grid to the cathode to keep a minus bias on the former and block its half of the tube.

When transformer polarity returns to that in Fig. 8, capacitors C_1 and C_2 are again charged. When contact D is opened, only C_1 is available to maintain the grid minus. This capacitor discharges through R_2 and normally its potential is reduced in about 0.5 sec to where the right-hand side of the tube can close the relay.

Time to Close Relay. The time required for the tube to close the relay after D opens can be changed by increasing or decreasing the resistance of R_3. Decreasing its resistance permits the relay to close sooner after D opens. Increasing R_2 resistance increases the time that the relay will hold open.

Speed of response—that is, the time contact D must remain closed before the grid has a minus bias that will block the tube—can be adjusted by changing the resistance of R_3. Eliminating this resistor by connecting D to the top of R_2 reduces the response time to about 0.002 sec. That is, the relay half of the tube is blocked in 0.002 sec after D makes contact. Normally this time is about 0.004 sec. The timing relays we have considered give a general idea of the principles used in such circuits. Also, we have had an opportunity to study some of the simpler electronic circuits before tackling the more involved. The next article will study 2-stage amplifying circuits.

Plant Problems

(Continued from page 120)

air temperatures leaving the heaters are much higher than the conventional 140 F. This causes discomfort to those in path of blast, stratification of air, and failure to project heat down to floor. The last trouble is a result of the limited air that can be passed through heater compared with that ordinarily passed when outlet temperature is 140 F or below.

Then there is the question of maintenance. I know of one heating system

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Spec. No.
3496
FOR HOT WATER—STEAM—AIR
The proper lubricant will assist greatly to obtain long packing life and prevent wear of the moving parts.
"ANCHOR" LUBRICATING COMPOUND Specification No. 5494 is especially compounded for Packing Lubrication
—DIRECTIONS—
Apply No. 5494 Lubricant with a paddle to the packing itself—And then also apply with a paddle to the rod or plunger and let the rod or plunger carry the lubricant to the packing.
Specification No. 5494
FOR COLD WATER
The proper lubricant applied to Cold Water Rods and Plungers will greatly assist packing performance and prevent wear of the moving parts.
"ANCHOR" Compound Specification No. 5495 is especially suited for cold water work.
—DIRECTIONS—
Apply No. 5495 Lubricant with a paddle to the packing itself—and then also apply with a paddle to the rod or plunger and let the rod or plunger carry the lubricant to the packing.
Specification No. 5495
FOR VOLATILE LIQUIDS
A PACKING LUBRICANT
For Rods, Shafts and Plungers in the presence of Gasoline, Propane, Butane, Carbon Tetra Chloride, etc.
—DIRECTIONS—
Since most of this No. 5496 lubricant is used on Centrifugal pumps apply No. 5496 lubricant with a paddle to the packing itself (and also on the rod or plungers if used on reciprocating rod or plungers).
Specification No. 5496
BRANCH OFFICES AND WAREHOUSES
KANSAS CITY
LOS ANGELES
MONTREAL
NEW ORLEANS
NEW YORK
PHILADELPHIA
PITTSBURGH
SAN FRANCISCO
ST. LOUIS
BALTIMORE
BOSTON
BUFFALO
CLEVELAND
CHICAGO
CINCINNATI
DETROIT
GALVESTON
GENERAL OFFICE
PHILADELPHIA, PA.
CAN AND CONTENTS MADE IN U. S. A.

Only $2.98 helps put new "sell" in television advertising

Sponsor of television show had to refilm his commercials to meet a new selling problem. New films picked up at studio 4 P.M., delivered to TV station 800 miles away 8:17 P.M. same evening. Air Express cost for 11-lb. carton, $2.98. (In *undramatic* fashion Air Express keeps radio, television or any business rolling.)

Remember, $2.98 bought a complete service in Air Express. Rates include door-to-door service and receipt for shipment—plus the speed of the *world's fastest* shipping service.

Every Scheduled Airline carries Air Express. Frequent service—air speeds up to 5 miles a minute! Direct by air to 1300 cities; fastest air-rail to 22,000 off-airline offices. Use it regularly!

Only Air Express gives you all these advantages

Nationwide pick-up and delivery *at no extra cost* in principal towns, cities.

One-carrier responsibility *all the way;* valuation coverage up to $50 without extra charge. And shipments always *keep moving.*

Most experience. More than 25 million shipments handled by Air Express.

Direct by air to 1300 cities, air-rail to 22,000 off-airline offices.

These advantages make Air Express your best air shipping buy. Specify and use it regularly. For fastest shipping action phone Air Express Division, Railway Express Agency. (Many low commodity rates in effect. Investigate.)

SPECIFY AIR EXPRESS

AIR EXPRESS — GETS THERE FIRST

Rates include special pick-up and delivery door to door in principal towns and cities

AIR EXPRESS, A SERVICE OF RAILWAY EXPRESS AGENCY AND THE SCHEDULED AIRLINES OF THE U.S.

whose unit heater coils of copper and return lines of steel corroded through in a short time when 125-psi steam was used. That part of system that operated with 40-psi steam gave no trouble.

System shown by *JC* includes neither a deaerating heater nor a hot-process softener. Former is a necessity even with a small amount of makeup if there is no hot-process softener. This always applies, even with steam at 5 psi.

Remember, when unit heaters are shut down by their thermostats, steam is still on and coils remain hot. Most unit-heater manufacturers try to protect their motors from this heat. I've had this source of trouble when operating heaters on 125 psi.

Then there is the question of operating economy. Most unit-heater installations use bare pipe returns with supply lines covered. Steam is turned on in fall and left on till spring. Increased radiation from both supply and return, when using steam at 150 psi instead of 50 psi, would be wasteful.

I would not consider the suggested system. *JC* should use steam at 50 psi unless there is a surplus of 5-psi steam at times. In that case he should buy low outlet-temperature heaters and put some of the system on 5 psi. Also, buy large capacity and fewer heaters; then use air diffusion devices to secure proper air distribution. Drop returns into vented receivers and pump to boiler plant.

E H Roper *Toledo, Ohio*

Consider Unit Ventilators

Unit-heater drip traps can be discharged into process line but it will be troublesome and a source of continuous, unnecessary expense. Some of the direct losses and troubles encountered are latent heat, removal of gases from the heater coils, need for larger steam drip traps on the process line, high ceiling temperatures causing excess heat losses through roof, baking of manufacturing dirt into coil fins, and erosion of connecting pipe nipples.

JC should keep in mind that unit heaters only recirculate room air. On the other hand, unit ventilators draw in outside air. Most economical would be a mixture of unit heaters and ventilators using maximum of 5 psi at farthest unit. With unit heaters only, steam pressure can be progressively lowered down to atmospheric as outside temperature rises. Using a mixture of both heaters, lowest steam pressure should be about 0.5 psi. This low-pressure steam-heating system with a mechanical removal of condensate, proves most economical in the long run. Remember, space heating by low-temperature mediums is cheapest. Hot water ranks first.

GULFCREST OIL

New 60,000 kw steam turbine recently installed at Plant Atkinson of the Georgia Power Company, Atlanta, Ga.

Another big turbine gets the safe, sure, long-lasting protection of Gulfcrest, the world's finest turbine oil!

Another case, too, where outstanding performance in other turbines operated by the same utility led to the selection of Gulfcrest Oil for the new unit!

Extra refining makes the difference! After the carefully selected crude oil used in Gulfcrest goes through the major refining methods, it is then supperrefined by the Alchlor Process.

More than 15 per cent of the oil is discarded by the Alchlor Process—this 15 per cent contains the hydrocarbons most apt to oxidize and form sludge, emulsifiers, and harmful acids.

That's why Gulfcrest is incomparably pure—why it gives outstanding performance, and lasts indefinitely. Send the coupon below for a booklet which gives you the complete facts on this superior oil.

Gulf Oil Corporation • Gulf Refining Company

Division Sales Offices:

Boston • New York • Philadelphia • Pittsburgh • Atlanta
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GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation • Gulf Refining Company P
3800 Gulf Building, Pittsburgh 30, Pa.

Please send me, without obligation, a copy of your booklet "Gulfcrest Oil for Steam Turbine Lubrication."

Name.....

Company.....

Title.....

Address.....

BUT YOU DO— *EVERY DAY!*

Bursting glass and scalding steam can play havoc in your boiler room. Safeguard the weakest link in your boiler room with double-layer SONDERGLASS, the SAFE gauge glass. SONDERGLASS is actually two layers of hand drawn glass whose components have different coefficients of expansion, fused together. The inner layer resists heat; the outer withstands the shock of sudden cold drafts. SONDERGLASS not only minimizes blowout hazards, it also cuts maintenance costs by resisting discoloration and clouding. Replace all water columns with SONDERGLASS now and discover how much better a hand drawn gauge glass can be!

Order from your local jobber and specify "SONDERGLASS—no substitution, please."

SONDERGLASS

THE SAFE GAUGE GLASS

PACKING
Chesterton
SERVICE
A. W. CHESTERTON CO.

Established 1884

6 ASHLAND ST. EVERETT 49, MASS.

subatmospheric steam second, and atmospheric steam, up to 5 psi, third.

On an installation similar to *JC's*, we reduced coal consumption from a 2-year average of 5231 tons to a 6-year average of 4140 tons besides adding three 24,000-cfm unit ventilators. Last, I recommended that *JC* read "Building Heating" in the June issue of POWER.

H M NOBIS *East Cleveland, Ohio*

LUBRICATION

(Continued from page 99)

tensively for lubricating locks, etc, where a liquid lubricant might cause small parts to stick. It is also mixed with semi-solid lubricants. There are also water and oil mixtures with an artificial amorphous graphite produced in the electric furnace.

Other Lubricants. Two other common but unrecognizable lubricants are water and air. Water lubricates steel shafts in wood or rubber bearings under water, as on hydro turbines. Moisture in vertical steam cylinders does some lubricating. Air (under pressure) is a lubricant in some high-speed centrifuges and was applied by Kingsbury in a small wedge-block thrust bearing.

In recent years we have heard much about synthetic produrts such as rubber, resins, chemicals and drugs. Synthetic lubricants have not been so well known. But recent developments have indicated that inte:esting materials can be produced synthetically for use in the lubrication field. Because of their different chemical make-up, these synthetics differ markedly in many respects from mineral-oil products, vegetable and animal oils and fats. The term synthetic refers to products built up from the elements or from smaller molecules. It does not mean the products are substitutes, or ersatz materials. The higher temperatures met throughout the iron and steel industry are providing a wide number of applications for synthetic lubricants.

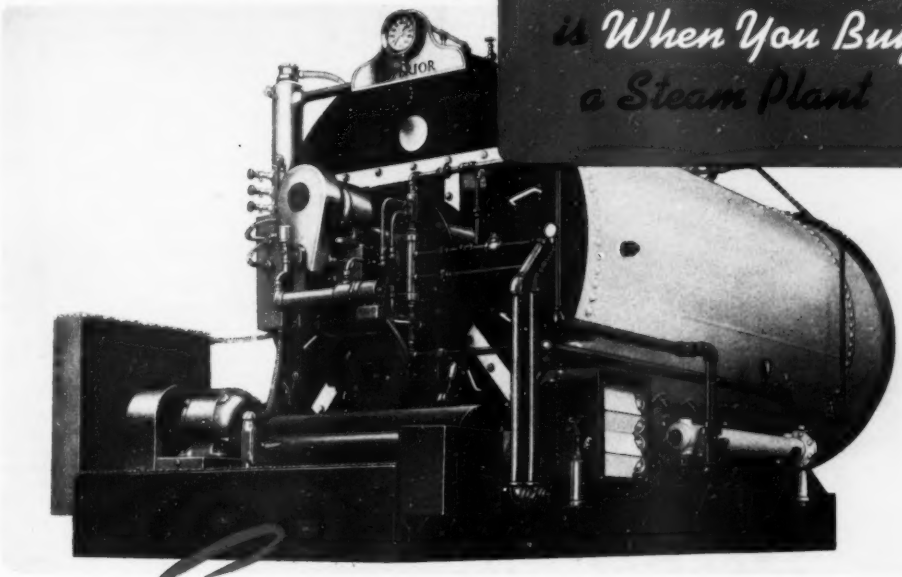
Refining Processes. Crude petroleums are refined, and finished products are manufactured, by using a succession of refining processes. Among them are distillation, absorption, cracking and use of chemicals. Distillation is always used in the first process of refining. From the lightest hydrocarbon gases to the heaviest refinery sludges, preparation of crude into various fractions is handled by distillation, and subsequent concentration.

Distillation process is shown in the sketch on page 99. One method used is to charge the still continuously with crude oil. The vapors are then passed through a series of condensers, each of which in turn automatically maintains a constant temperature, but each at a different temperature. The first condenser is

The time to think of

OPERATING COSTS

is When You Buy a Steam Plant



Superior STEAM GENERATORS

PAY DIVIDENDS IN LONG-LIVED ECONOMY

Not for today alone . . . nor for the next few months . . . but for **years** to come . . . your Superior Steam Generator will continue to generate low-cost steam at high efficiency. Based upon long years of combustion engineering experience, its design embodies features which assure maximum long-run economy; for power engineers are well aware of the fact that an inefficient boiler can waste more than its cost in a few years.

Its rugged, heavy-duty construction is visible evidence of its long-lived dependability; for Superior's greater weight per boiler horse power, and larger heating surfaces contribute measurably to long-run economy . . . assuring performance at capacity ratings year after year after year.

Unlike the car you drive . . . which you trade in for a new model every few years . . . steam generators should be built to give long years of satisfactory service. Make sure that the steam generator you buy has the features which insure both long life **and** economy.

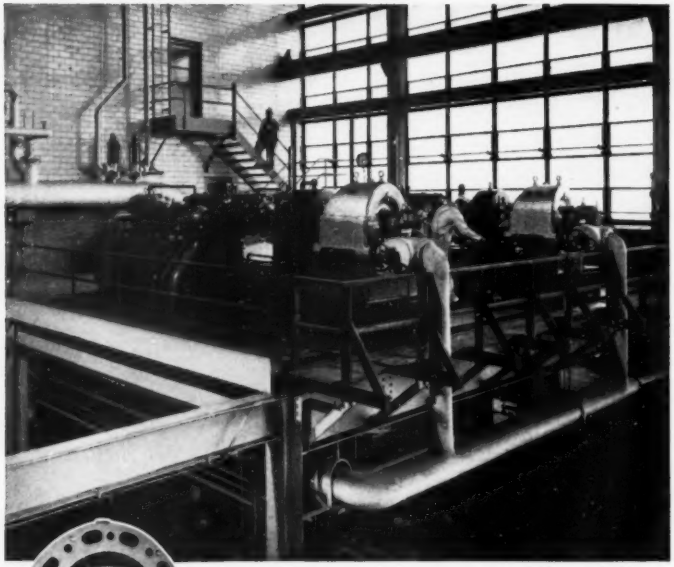
Look for fully automatic operation with any grade of oil . . . or gas . . . for fully automatic operation is truly an economy. Look into Superior's built-in induced draft. Compare heating and evaporating surfaces. Compare both size and weight.

Then see a Superior installation and observe the little details . . . wiring, fittings, its own specially designed burner, and last of all, its sturdy construction.

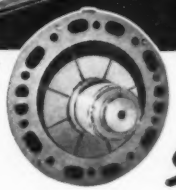
You can see the difference, if you'll look. For complete details write for Catalog 101.

Superior Combustion Industries, inc.

Factory: Emmaus, Pa.
Executive Offices: Times Tower, Times Square, New York 18, N. Y.



PHOTO—HEDRICH-BLESSING



SHERWIN-WILLIAMS

INSTALLS

FULLER ROTARY COMPRESSORS

IN NEW BOILER HOUSE

Long delayed, due to difficulties encountered in obtaining materials and equipment during the war years, the much needed new boiler house of The Sherwin-Williams Company Chicago plant, was put into operation during the early part of 1947. However, this delay permitted further study and adoption of the latest techniques, and several unique dividend-paying features.

Fuller Company is justly proud to have been given the opportunity to supply two "lifetime-efficient" Fuller Rotary Compressors for this most modern and efficient industrial plant. These compressors are of the two-stage type, each having a capacity of 1592 c.f.m., free-air, at 120-lb. pressure, driven by 350 hp. turbines, equipped with speed reducer, to operate at 575 r.p.m. They furnish air for both factory and power house service.

Bulletin C-5, illustrates and describes Fuller Rotary Compressors and Vacuum Pumps. We'll be glad to send you a copy.

FULLER COMPANY

CATASAUQUA—PENNSYLVANIA

Chicago 3 - 120 So. LaSalle St.

San Francisco 4 - 420 Chancery Bldg.

C-181

A LIFETIME OF NEW MACHINE EFFICIENCY

FULLER

held at the highest temperature and each succeeding one at a lower. The fraction having the highest boiling-temperature range is condensed first. That having the second highest is condensed next, etc. This continues to the last condenser in the series where the fraction having the lowest boiling-temperature range is condensed. This is known as *fractionation by condensation.*

It should be fully realized that the process of petroleum refining is much more complex than indicated above. The reference is included here merely as an introductory thumbnail sketch to a vast, complex process.

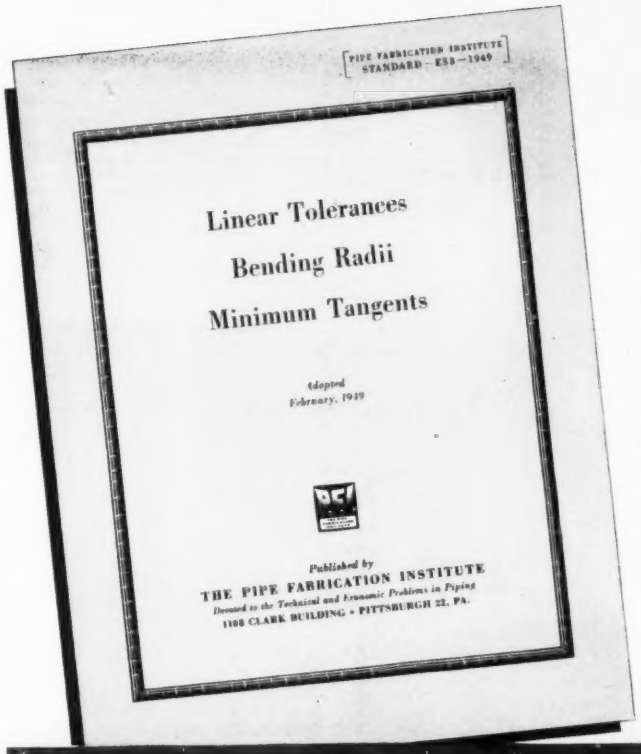
Central Hudson Gas & Electric Corp. of Poughkeepsie, N. Y., has engaged consulting engineering firm of Burns and Roe, Inc, New York, N. Y., to design a steam-electric generation station for construction at Danskammer Point, N. Y., according to an announcement made by Ernest R Acker, president of the corp.

This plant will have gross capability of 66,000 kw developed by a 60,000-kw reheat turbine-generator, operating at a pressure of 1650 psig at the throttle, with an initial temperature of 1000 F and a reheat temperature of 1000 F. Basically the design of this plant will conform to standardized power-plant designs developed by the engineers. In these designs the turbine-generator is mounted on and supported by the condenser; all moving equipment is confined to the basement and operating floor, with exception of coal-handling equipment; and the arrangement of equipment is engineered to effect the greatest economy in building space and cubage.

Members of Congress, Governor Ondahl of North Dakota, and other federal and state officials took part in ground-breaking ceremonies for the new Bureau of Mines' lignite research laboratory at Grand Forks, on the campus of the University of North Dakota on July 22. Contracts totaling $544,484 were awarded early this month, construction is to get under way at once and the building is to be ready for occupancy in about a year, Dr Ralph L Brown, chief of the bureau's coal branch, said recently.

Mississippi Power Co is increasing the initial installation of the generating unit at its new Meridian plant from 40,000 to 58,000 hp, according to L P Sweatt, president. The change in generating capacity will increase cost from $5,000,000 to $5,500,000. It will be one of the largest steam-electric generating plants in the state. The company will construct a 110-kv transmission line from the Meridian plant to the one at Hattiesburg, a distance of about 110 miles.

Moffett & Troop, Inc, Pittsburgh 22, Pa., submitted the lowest bid, $185,564, to the city of Ames for Contract No. 20 of the municipal light and power-plant improvements, including the power piping. Burns & McDonnell Engrg Co, Kansas City, Mo., are the consulting engineers.



PFI Standard for Linear Tolerances Bending Radii and Minimum Tangents in Fabricated Piping

"Standardization" Assures Quality and Promotes Economy

The designer of prefabricated piping will find this PFI Standard very helpful in his work. Standard ES3 has to do with general shop fabrication standards that have been adopted by the PFI after much study of the economic factors as well as technical and manufacturing questions. This Standard will save time for the designing engineer and help assure piping that is in accordance with modern shop practices.

If you desire copies of this Standard without cost (and of others as issued) simply fill in coupon below and mail to the offices of the Institute.

3988

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

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The Pipe Fabrication Institute,
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Please send me without cost the PFI Standards now available, also place my name on your mailing list to receive additional Standards as they are adopted.

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Title _____

Company _____

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RODA

High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

IDENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX

A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

GLENBROOK

The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE

Roda and Stonega from Wise County, Va.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER

Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

LYNCO

High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Vgn. Ry.

Old Kentucky

Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

ANTHRACITE

Hazle Brook and Raven Run Premium Coal.

Our personnel with the experience gained through long and varied marketing activity assures effective servicing of any fuel requirement.

General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

BRANCHES:

BLUEFIELD, W. VA. BOSTON BUFFALO CHARLOTTE, N. C.
CINCINNATI NEW YORK NORFOLK PITTSBURGH

New Equipment

(Continued from page 142)

P1059 • WELDING FITTINGS—*Flowline* stainless-steel welding fittings come in five different ranges of wall thicknesses and sizes, and in three different stainless alloys. Wall thicknesses are made to conform to Schedules 5, 10, 40, and 80 specifications in pipe sizes of ½ to 12 in.

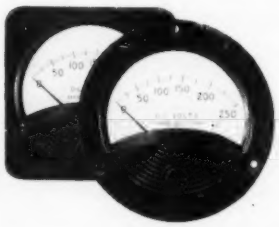
OD tube size fittings are made in outside diameters from 1 through 6 in. Standard stainless-steel alloys are types 304, 316, and 347.

Welding Fittings Corp, New Castle, Pa.

P1060 • DIESEL POWER UNIT—Two models of the *DIX4* series of 4-cylinder engines—*DIX4B* and *DIX4D*—are now available as closed power units suitable for application in the petroleum, mining, construction and other fields. Model *DIX4B* is 3¼x4 in. with a displacement of 133 cu in., while Model *DIX4D* is 3⅝x4 in. and 166 cu in.

These units are solid-injection 4-cycle design with full pressure lubrication, patented Hercules combustion chamber, American Bosch individual plunger-type injection pumps, Bosch pintle-type nozzles, five main bearings, counterbalanced and *Tocco*-hardened crankshaft, and high-lead bronze steel backed bearings.

Hercules Motors Corp, Canton, Ohio.



P1061 • PANEL INSTRUMENTS—Line of 2½-in. panel instruments is suitable for electronic devices, test equipment, etc. when only limited mounting space is available. Meters are identified as Types *DW*-71 (dc current), *DW*-72 (thermocouple,

Stymied!

OUR 50th YEAR
1899 1949

A TASK FOR A "PRO"—Making this shot is a rare feat for the "play-for-pleasure" golfer but the club "pro" could handle this "in his stride" because that's his business. Like the "pro", it's our business to know how to solve piping problems that "stymie" the maintenance engineer who doesn't have the required specialized shop facilities, nor the benefit of everyday experience in the intricacies of piping engineering. To back us up, we have 50 years' experience, and the organization to relieve you of all piping details, from preliminary engineering to final completion. The repeat contracts we've received from some of the country's largest utilities and industrial plants prove satisfaction on large and small projects. For your next piping job, rely on a "pro" in pipe engineering and call us. When you are making your piping plans, also investigate the Mitchell-Westport Joint which prevents metal protrusions inside the pipe without the use of backing rings. Write now for our bulletin "Something New in Welding" which tells all about it.

REPRESENTATIVES IN BOSTON, NEW YORK, CLEVELAND, MOBILE AND HAVANA

WESTPORT JOINT
(PATENTED)
W. K. MITCHELL & CO., INC.
2944 ELLSWORTH STREET
PHILADELPHIA 48, PA.
SINCE 1899

MITCHELL
PIPING FABRICATORS AND CONTRACTORS

MODERNIZATION *Demands...*

G-E Motor Control Centers

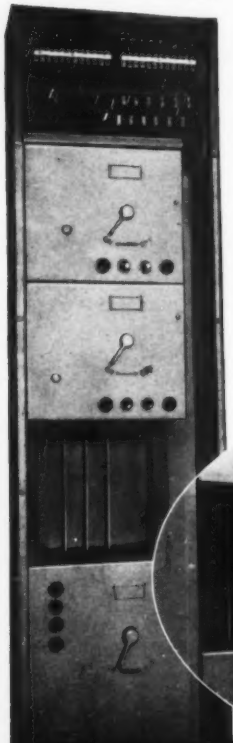
for EASY, LOW-COST INSTALLATION

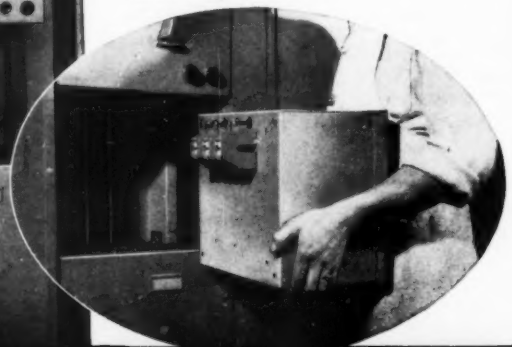
FLEXIBLE ARRANGEMENT

SIMPLIFIED SERVICING

These advantages, plus many more, are yours when you buy economical, G-E motor control centers. Only 12 inches deep, front connected, pre-engineered, can be factory assembled, wired, and tested. Individual sections can hold combinations of two or more sizes of starter units. (NEMA Size 1, 2, 3, and 4 for 1 to 100-hp a-c motors, 440 volts or below). Standard starters in standard vertical sections simplify installation, servicing, and stocking spare parts, yet permit flexible arrangements.

In addition, each unit is "wrapped in steel," has built-in short-circuit and overload protection. Wiring troughs are five inches wide, terminal and incoming bus may be at top or bottom as you prefer—all easily accessible. Wiring time is cut because "clothespin contacts" (below) connect to incoming power in one quick shove. Write now for more details in Bulletin GEA-4979. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*





GENERAL ELECTRIC

DW-73 (rectifier) and *AW*-72 (iron-vane).

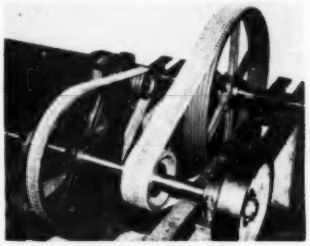
They are available in either round or square cases in all preferred ratings. Housed in black molded and moisture resisting dustproof textolite cases, the instruments are accurate within 2%.

General Electric Co, Schenectady 5, N.Y.

P1062 • PIPE-THREADER — Faster working speed, automatic chucking are claimed for *Thred-O-Matic* 44 in. mechanical pipe threading machine that handles pipes from ½ in. to 4.

All the operator need do is lay the pipe in the spindle, flip a switch and the pipe is chucked, centered and turning.

Quijada Tool Co, Los Angeles, Calif.



P1063 • MULTIPLE V-BELT—Quick detachable *Vee-Ply* V belt is designed for service emergency breakdowns and can be adapted to most V-belt drives. Suited for use on drives requiring dismantling a part of the machine to install endless belts, it is easily uncoupled from roll stock as needed and is adjustable to any length.

Belting is flexible and presents no problem of internal friction, thus maximum horsepower ratings can be had with minimum sheave diameters. It is recommended for continuous heavy-duty service, but not for severe shock loads or on drives that are under-belted.

Worthington Pump & Machinery Corp, P O Box 953, Buffalo 5, N.Y.

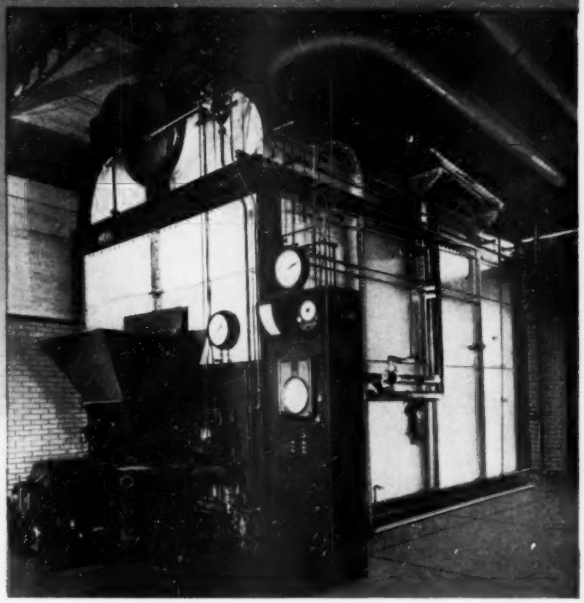
P1064 • ANION RESIN — *Amberlite* IRA-400 is a strongly basic anion resin that can be used to convert salts to corresponding free bases of metallic ions. It will absorb negatively charged ions from acid, neutral and even mildly alkaline solutions

UNION "S" STEAM GENERATOR

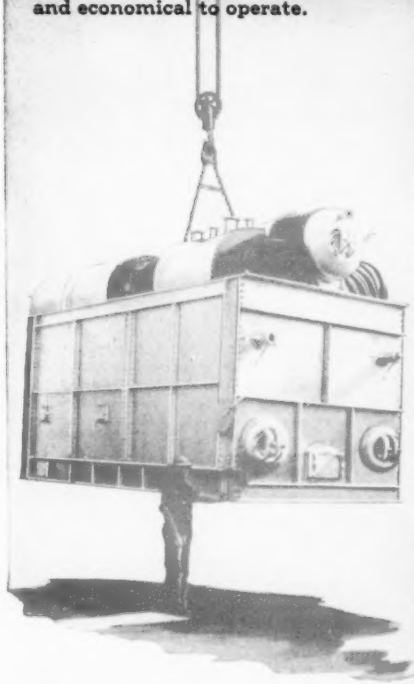
WATER COOLED FURNACE . . . SHIPPED ASSEMBLED

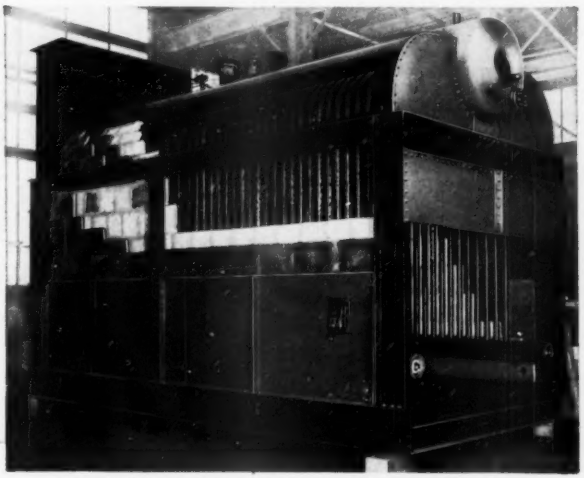
Change your dingy boiler room into a show spot.

This *compact* Union "S" Steam Generator with its completely steel clad, insulated setting and streamline appearance is as efficient as it looks. You'll be surprised how little floor area and height is required. You can profit from efficient furnace cooling and adaptability to low grade fuels. Its large water holding capacity, its rapid and positive circulation make it extremely safe and economical to operate.



This large tool manufacturer knows that it pays to use modern machines, so why not a modern power plant? He has it in the Union "S" Steam Generator.





Union "S" Steam Generator being assembled—note side and top wall construction—fire clay tile—block insulation and steel casing.

Write FOR BOOKLET 119

UNION IRON WORKS . . . *Since 1890*

1091 CASCADE STREET • ERIE, PENNA.

BOILERS • PROCESS EQUIPMENT • FABRICATED STEEL

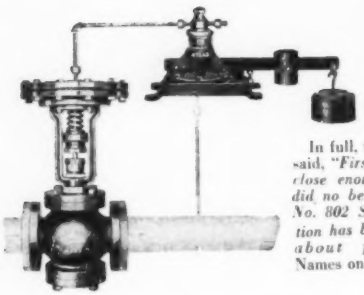
ATLAS
Super-Sensitive
PRESSURE REGULATORS

TRADE MARK REG.

"Then they installed an ATLAS No. 802

SUPER-SENSITIVE

and since then operation has been just about perfect."



In full, this is what the ATLAS representative said, *"First, a diaphragm valve did not regulate close enough. Second, a pilot operated valve did no better. Then they installed an ATLAS No. 802 Super-Sensitive and since then operation has been just about perfect."* Names on request.

In other words

THE JOB WAS TOUGH

for other regulators, but it was EASY for an ATLAS Super-Sensitive Pressure Regulator.

The above report is typical of ATLAS Super-Sensitive regulators. They maintain constant controlled pressures within fractions of one pound without perceptible variation under unusual and even difficult conditions, as, for example, where there is a wide fluctuation in demand and considerable variation in initial pressure.

The use of water pressure for the operation of the control valve eliminates any possibility of variations in the initial pressure affecting the controlled pressure, and at the same time provides the regulator with a power that makes it responsive to the slightest variation in the controlled pressure.

Ask for Bulletin No. 1B

We cannot give complete data here but you will find it in Bulletin 1-B which gives sizes, prices, typical installations, and various designs of this type of ATLAS Regulator.

Briefly, No. 801 is for reduced pressures 2 to 15 lb. No. 801-8 is for reduced pressures 0 to 5 lb. And No. 802 is for reduced pressures 15 to 150 lb. Sizes ½", ¾", 1", 1¼", 1½", 2", 2½", 3", 4", 5", 6".

ATLAS VALVE CO.
289 South St., Newark 5, N. J.
Please send complete information on the ATLAS products as checked at the left.

Name
Firm
Street
City State

- ☐ Super-sensitive Pressure Regulators
- ☐ Other Pressure Regulators
- ☐ Damper Regulators
- ☐ Temperature Regulators
- ☐ Reducing Valves
- ☐ Exhaust Control Systems
- ☐ Pump Governors
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ CAMPBELL Boiler Feed Water Regulators
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

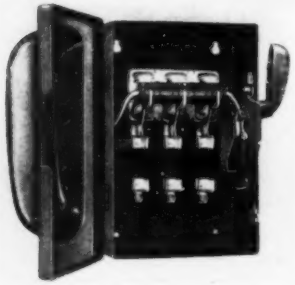
ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

289 South St., Newark 5, N. J.
Represented in Principal Cities

in a pH range from 1 to 10 and can be used for direct removal of silica from boiler feedwater.

The resin behaves as solid caustic with only its hydroxyl ions in solution. Manufacturer says the resin can be mixed intimately with a strong cation exchanger to prepare an adsorbent that will completely deionize solutions in one column and in one step.

Resinous Products Div, Rohm & Haas Co, Philadelphia, Pa.



P1065 • SAFETY SWITCH—Three new safety switches are: (1) Type *A*, heavy-duty industrial service (2) Type *C*, standard-duty industrial service (3) Type *D*, general-purpose service. Current carrying parts are silver plated and blades are visible for quick checking of switch.

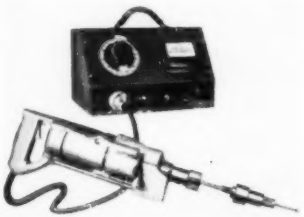
Magnetic plate in arc chamber cover adds to unusually high rupturing capacity. Non-tracking insulation is used in base. Units are available in 30- and 60-amp. sizes.

Square D Co, 6060 Rivard St, Detroit 11, Mich.

P1066 • RUST INHIBITOR—Deeper penetration, high gloss, tougher weathering are claimed for *TOTRUST*, a rust-inhibitive paint primer and finish coat that gives 800-1000 sq ft coverage per gallon.

Applied over damp surfaces it is said to squeeze moisture to surface by capillary action and to get into rusted pits and stop further corrosion.

Wilbur & Williams Co, Greenleaf and Leon St, Boston 15, Mass.



P1067 • TUBE EXPANDER—Electric tube rolling control eliminates factor of human judgment and determines when tube joint reaches the maximum degree of tightness. Device consists of a control mechanism, operated with a dial calibrated for the known expansion peak of each type of

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.

View of Public Service Electric and Gas Company's new 1500 psig., 1050 F. power station at Sewaren, N. J.

These "firsts" mean piping that lives longer

IN ADDITION to laboratory tests and actual performance figures, there are still other ways to predict the probable life of power piping. One is to look at the record of the company that fabricates the piping—to see what unusual challenges it has met and solved.

Here are three recent fabricating problems overcome by Kellogg, all connected with the high temperature piping at Public Service Electric and Gas Company's new Sewaren Generating Station in New Jersey.

Kellogg was the first to fabricate power piping to operate at 1050 F. It was not a simple job. Nothing could be allowed to go wrong in piping as important as this.

As part of this job Kellogg also fabricated the first 18-8 alloy steel (power) piping for high temperature service. It was designed to connect the throttle valves and steam chests of three turbines operating at 1500 psig. There just couldn't be any defects, any locked-up stresses, any faulty metal formations, or deviations from contour.

In addition, Kellogg created for this same plant a special bi-metallic transition piece through the use of an exclusive electric ingot casting process. It was the first of its kind and was cleverly devised to make a junction, between Croloy boiler leads and Stainless Steel (Type 347 and 316) throttle valves, that eliminated the possibility of failure from expansion stress. This piece precluded the necessity for a tricky welding job that might fail because of a 50% difference in thermal expansion between the two alloys.

These are just some recent Kellogg "firsts" to keep in mind when you place orders for power piping today. You know that each piece of piping delivered, bearing the Kellogg stamp, has not only thirty years of experience behind it, but also the creative thought that met and bested these unusual challenges. You can be sure that know-how like this means power piping that lives longer.

To master temperature, pressure and chemicals use

M. W. KELLOGG

process equipment

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

ADSCO introduces

ADSCO

Corruflex

PACKLESS EXPANSION JOINTS

Corruflex, ADSCO's new packless corrugated expansion joint, rounds out the most complete line of expansion joints available from any manufacturer. Only ADSCO can make both an expert analysis of your expansion problem *and* an impartial recommendation of the type of joint to use.

Corruflex, because it is packless, is ideally suited for remote and difficult-to-service installations.

Corruflex is economical because it makes expensive pipe bends unnecessary.

Corruflex is available in sizes from 3" to 24", single or double units, single or multiple corrugations, with or without self-equalizing rings and with flanged or welding ends. It is supplied in copper, stainless steel or other alloys and with internal sleeves if required.

Corruflex has a traverse range from fractions of an inch to 15" and will operate under pressures from vacuum to 300 lbs. and temperatures from sub-zero to 1600° F.

For further details, consult your ADSCO representative or write for Folder No. Z-149.

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N. Y.
SINCE 1877

metal, an electric expander driving motor, and either a *G*-800 or *G*-1200 ball-bearing type condenser and heat-exchanger tube expander.

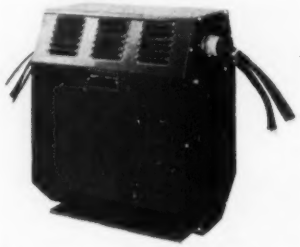
Using 110-v, 60-cycle current the control may be plugged into any convenient outlet. It can also be furnished for dc. When maximum torque is reached the control automatically cuts off the power, motor reverses and operator may then withdraw expander.

Airetool Mfg Co, 334 S. Center St. Springfield, Ohio.

P1068 • AC LOAD VISUALIZER — Besides serving as a standard 0-2.5/5/25/50-amp ammeter and a 0-150/300/600-v voltmeter, the load visualizer may be used with a split-core or conventional instrument transformer to extend range for determining watts, vars, volt-amperes, and power factor. Designated as Type AF-2, the new instrument can be used in load surveys, induction motor tests, reactive power studies, and power factor checks in power and lighting circuits.

Unit is self-contained to 50 amp, extended to 1000 amp by split-core current transformer. This hook-on feature enables surveys to be made without interrupting service or cutting conductors.

General Electric Co, Schenectady 5, N.Y.



P1069 • DRY-TYPE TRANSFORMER —These transformers have two rated-kva 5% taps below rated primary voltage, enabling user to get 120/240-v output from undervoltage supply lines.

Rated from 1-50 kva inclusive, Type *M* and *D* transformers are for both 480- and 600-v supply lines with series-multiple sec-

How to *INCREASE BOILER RATINGS*

with your present furnace and stack

Coppus-Dennis FANMIX Burners Give You More Heat with No Other Major Change in Equipment

Coppus-Dennis **FANMIX** Burners give you *perfect* mechanical mixing of fuel and air *at the burner outlet . . . instantaneous* ignition close to the burner . . . and *complete* combustion *without visible flame* when burning natural gas. No other burner combines these three advantages.

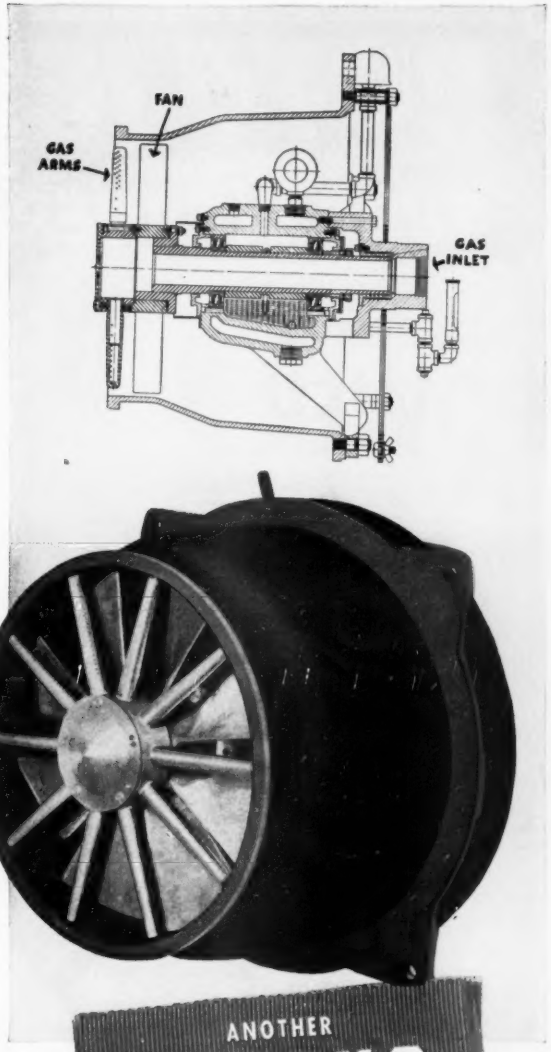
Because **FANMIX** delivers the *right* mixture of fuel and air *without blow-torch action*, all of your furnace space is used for combustion . . . *none for mixing*. That's why your present furnace can release more heat . . . why new installations can get more heat out of smaller furnace space.

Because **FANMIX** can be guaranteed to secure complete combustion of natural gas *with less than 5% excess air*, you get uniform "radiant heat" *without drifting hot spots*. That's why a **FANMIX**-fired furnace seldom varies in temperature more than 5% over its entire area.

WRITE FOR ALL THE FACTS

When you see in Bulletin 410–5 how fuel escaping from orifices in rotating driver arms rotates the fan to draw the correct proportion of air into the path of the fuel at right angles . . . how **FANMIX** creates its own forced draft, reduces stack requirements, prevents cracking of "wet" gas . . . how two **FANMIX** types handle either gas or oil or any combination of both — you'll understand why **FANMIX** Burners have such wide acceptance in oil refineries and power plants.

Send for the Coppus-Dennis **FANMIX** Bulletin 410–5. Coppus Engineering Corporation, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, and REFINERY CATALOG.



ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP.
170 **Park Ave., Worcester 2, Mass.**
Please send Bulletin 410–5 to:

Name .....

Company .....

Address .....

ROTOJET
Water-driven
TUBE CLEANERS

Deliver all the
POWER
you need for
QUICK RESULTS

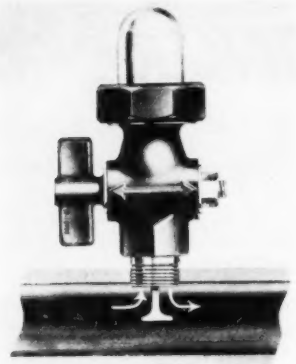
ROTOJET Water-driven Tube Cleaners provide power heretofore obtainable only with air-driven equipment. A vast increase in power and a material reduction in water consumption were achieved through radical design changes based upon latest research in hydrodynamics.

The new ROTOJET removes the hardest scale much more quickly and efficiently than ever before possible with water-driven equipment. Send for new ROTOJET Bulletin.

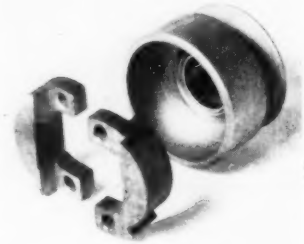
C321 ROTOJET Water-driven Motor with short 4-arm head and universal joint for 2¼" I.D. straight tubes.

ELLIOTT COMPANY-ROTO DIVISION
153 Sussex Avenue **Newark 1, N. J.**

ondaries. They are useful in lighting installations where some voltage adjustment may be necessary to maintain efficiency of light output.
General Electric Co, Schenectady 5, N.Y.



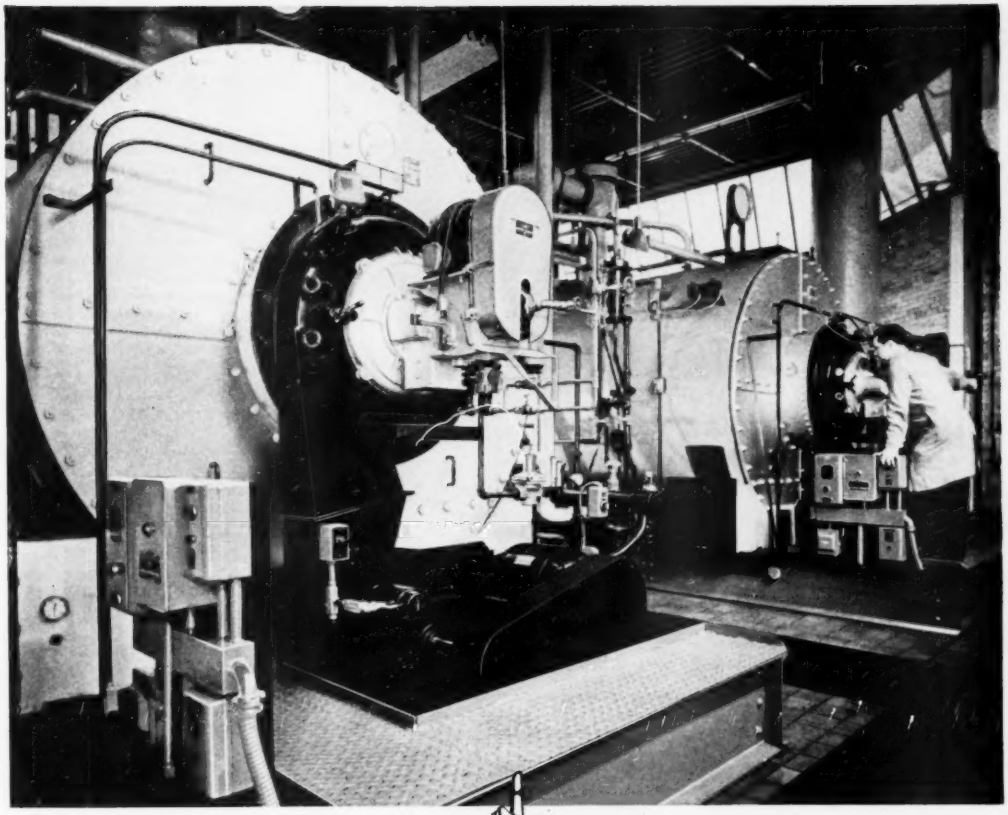
P1070 • SIGHT GLASS — Valve type sight glass permits observing clarity or turbidity of transparent liquids flowing under pressure through pipelines. Differential pressure established across deflector allows some of the liquid to circulate continuously through glass observation bowl. A special feature permits removal of observation bowl for cleaning.
Worthington Pump & Machinery Corp, Harrison, N. J.



P1071 • FRACTIONAL-HP CLUTCH —Sintered-metal powder parts for a clutch for fractional-horsepower motors have cup and flange produced from an iron-base powder mix while the brake shoes are made from a leaded-iron-copper material.
Yoder Clutch Co, Orrville, Ohio.

P1072 • TRANSFORMER CONTROLLER—An emergency control handle for *CPS* transformers makes possible temporary emergency operation during overload periods. Device is designed for times when it is impossible or inexpedient to replace an overload transformer immediately.

Emergency control handle is a small red lever under breaker operating handle and normally sealed with a meter seal. When seal is broken and lever pulled down, bimetal actuating element of secondary breaker is readjusted so it can carry higher over-



Never *Forget*

BOILERS BURN DOLLARS . . .

Yes — generating steam costs money — money for fuel, boiler operation, care and maintenance. An old or outmoded fuel-wasting boiler can burn many hidden dollars through excessively high steam costs.

It's sound business to install boilers that give you the most for your steam dollars — modern, guaranteed high efficiency Cleaver-Brooks boilers, using oil or gas as fuel.

For any boiler installation (15 to 500 HP.)—new or replacement—Cleaver-Brooks offers these immediate and long-range cost-saving advantages:

A Custom-Planned Boiler Engineered for Your Needs: Your steam needs and steam-using equipment are studied — your present steam load plus your estimate of future expansion are considered — with this information the size of Cleaver-Brooks Boiler best suited to your specific needs is determined.

Factory Starting Service: Your boiler is placed in operation by Cleaver-Brooks factory service-engineers. Your operators are trained in operation, care and maintenance.

Flexible Operation Burning Gas or Oil With Equal Efficiency: You can use oil, gas, or combination oil and gas, whichever is of lower cost. Through their high heat transfer, Cleaver-Brooks boilers operate at a guaranteed efficiency of 80% from full load down to 30% of rating.

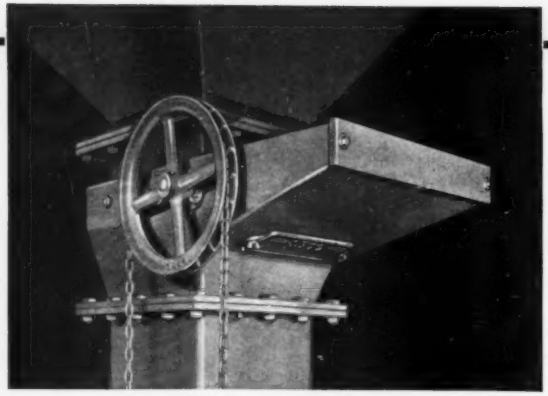
In addition, Cleaver-Brooks boilers give you clean, smokeless operation — eliminate fuel and ash handling — require no high or costly stacks — no special foundations — fit under low headroom — provide quick steaming, flexible operation to meet fluctuating loads — fully meet all codes.

Available in sizes 15 to 500 HP., 15 to 200 P.S.I. — write for Cleaver-Brooks steam boiler bulletin.

CLEAVER-BROOKS COMPANY
332 E. Keefe Ave., Milwaukee 12, Wis.

WRITE on your business letterhead for Steam Cost Calculator—a ready reference slide rule showing comparative steam costs when using oil, gas, or coal as fuel. Mailed on request — no obligation.

Cleaver-Brooks
STEAM BOILERS



S-E-CO. COAL VALVES always operate easily because they are equipped with double racks and pinions. This design moves the gate squarely and without binding. S-E-Co. Coal Valves fit the requirements of today's modern plants.

Send request for bulletin to

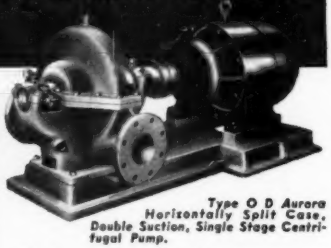
STOCK ENGINEERING COMPANY
715P Hanna Building ★ Cleveland 15, Ohio

INTEGRITY *Counts in* **PUMPS,** *too*

This Truly Great **AURORA TYPE O D CENTRIFUGAL PUMP**

for general water supply, for municipalities, industrial establishments.

also for handling condenser circulating water, wash water, liquids in paper mills and distilleries, chemical solutions, oils in oil fields and refineries, irrigation, etc.



Type O D Aurora Horizontally Split Case, Double Suction, Single Stage Centrifugal Pump.

The ultimate in design and perfection—type O D pumps—in capacities to 4,000 G.P.M. and heads to 300 ft.—are accessible, compact and lasting. The horizontally split-case type of design permits removal of upper half of casing without disturbing suction or discharge. The impellers and water channels are streamline designed to minimize flow resistance and avoid turbulence, cavitation and consequent corrosion and erosion.

***Write for* CONDENSED CATALOG "M"**
and O D Bulletin 105

APCO TURBINE-TYPE PUMPS
For high pressure, Small capacity requirements (up to 150 G.P.M.). Wide operating range characteristics. No metal to metal contacts. Handles non-lubricating liquids without wear. Only one moving part—the Impeller.

DISTRIBUTORS IN PRINCIPAL CITIES

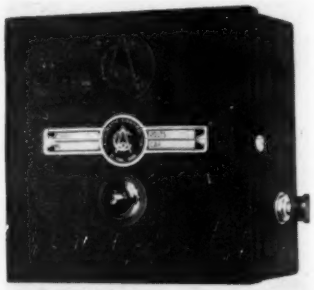
AURORA Always PUMPS — **AURORA PUMP COMPANY**

50 Loucks Street, AURORA, ILLINOIS

loads for a longer period of time. When so set, the circuit breaker still gives short-circuit protection.
Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa.

P1073 • DIESEL ENGINE — Supercharged *NHRS*-600 diesel, available in industrial, marine and automotive models, develops 300 hp at 2100 rpm. It incorporates a new fuel pump based on Cummins' principles of metering and injection but 56% smaller and 65% lighter, a fully counterbalanced crankshaft, improved piston design, tubular oil cooler.

Fuel consumption in the high-horsepower-output range has been reduced. Except for smaller fuel pump and new oil cooler, engine has same size and installation dimensions as the *NHS*-600 engines.
Cummins Engine Co, Columbus, Ind.



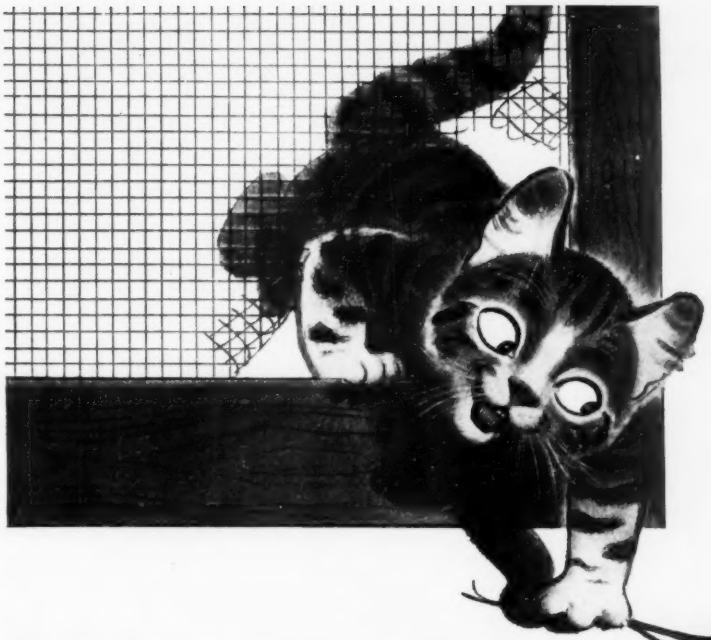
P1074 • EMERGENCY ALARM — *Silencer* may serve with any electrical alarm circuit that indicates emergency conditions such as pressure, liquid level, temperature, smoke, gas, overload, etc. It provides continuous protection even though warning sound is stopped.

When emergency condition arises alarm is stopped by pressing button on side of case. Glowing red light remains on until trouble is corrected. When circuit is clear, the *Silencer* automatically resets itself and light goes out.
Automatic Control Co, St. Paul 4, Minn.

P1075 • SPOT-WELDER — Portable, only 23 lb, self-operating spot welder for 110 or 220 v, 50-60 cycle service, welds up to ⅛ in. thickness of metal or up to 2 pieces of 18 gage galvanized.

Unit comes in a compact, non-corrosive cast-aluminum housing. It has a transformer wound with double spun-glass insulated magnet wire. The transformer core consists of high-grade electrical silicon steel.
Greyhound AC Arc Welder Corp, 606 Johnson Ave, Brooklyn 6, N.Y.

P1076 • COUPLING COVERS—Plastic covers for chain couplings are molded of rag-filled phenolic plastic for maximum strength with minimum weight. The plastic material used is highly resistant to practi-



*PENETRATION

Peak production . . . without worry of breakdown due to friction and wear . . . is made easier with Tycol high quality greases.

Made to "absorb punishment" without thinning down and dripping, Tycol greases avoid wasted lubricant, lost bearings and unnecessary down-time. These ultra-safe lubricants keep bearings . . . gears . . . shafts . . . friction-free and cool. They are available in grades with the proper "*PENETRATION" needed to give power a chance to produce with a minimum of waste.

Call your nearest Tide Water Associated office. Let them suggest the Tycol grease best suited to your needs . . . and remember, Tycol green cast greases are made from high quality cylinder stock and well refined neutral oil, with a minimum of soap — a maximum of oil . . . more efficient lubrication per pound of grease.

TYCOL
INDUSTRIAL LUBRICANTS

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TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N. Y.

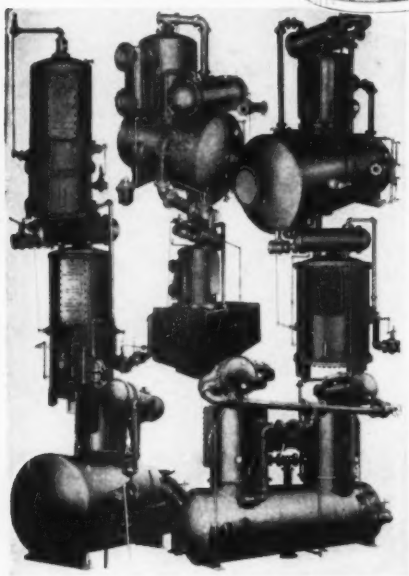
*LEARN WHAT THIS PRODUCT CHARACTERISTIC MEANS TO YOU — READ "LUBRICANIA"
This informative handbook, "Tide Water Associated Lubricania," gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases. For your free copy, write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

REFINERS AND MARKETERS OF VEEDOL — THE WORLD'S MOST FAMOUS MOTOR OIL

Cost-Reducing Performance

IN ANY TYPE, SIZE, OR CONSTRUCTION OF

STICKLE **OPEN COIL** HEATER



STICKLE HEATERS

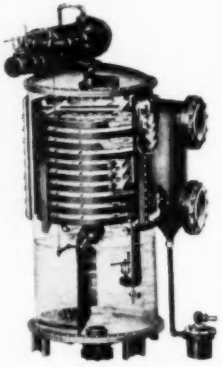
—supply greater heating capacity in less space.

—provide makeup water for boilers with non-condensable gases eliminated and scale-forming substances depleted.

—add steam condensed in heating raw water to boiler feed supply, making one-sixth of makeup distilled water.

—afford continuous, trouble-free service, with long life.

Raw water, entering heater from top, is in direct contact with steam, which fills heater shell, throughout course of travel. Flowing in thin, animated film and dropping from tray to tray, heat from steam is rapidly transferred and feedwater is delivered to pump at temperature of saturated steam in heater.



• Whether requirements call for a small or an extremely large volume of preheated and purified water, there is a Stickle Open Coil Heater to meet the need—in Deaerating or Non-Deaerating Type, in Cast Iron or Steel Construction, with standard or special storage capacity. A few examples are shown above. Stickle Heaters are adaptable to space and other conditions of installation, and are alike in simplicity of design, in functioning efficiency, and trouble-free operation. Bulletin No. 117, on request, gives additional information.

STICKLE STEAM SPECIALTIES COMPANY
2265 Valley Avenue, INDIANAPOLIS 18, INDIANA

Successfully Serving for More than 40 Years Paper Mills, Food Processors, Textile and Hosiery Mills, Laundries and Other Manufacturers Using Steam for Industrial Processing

STICKLE EQUIPMENT

STICKLE DIFFERENTIAL AND BOILER RETURN SYSTEMS • STICKLE OPEN FLOAT STEAM TRAPS • STICKLE REGULATING AND REDUCING VALVES • STICKLE OPEN COIL FEED WATER HEATERS AND PURIFIERS • STICKLE OIL AND STEAM SEPARATORS STICKLE TEMPERATURE CONTROLLERS AND OTHER SPECIALTIES

cally all acids and alkalies and is immune to rust.

Covers are streamlined for safety, provide sealed-in lubrication and maximum protection. The 2-piece construction, with slot head screws, requires only an ordinary screwdriver and permits easy installation after the coupling has been completely installed.

Morse Chain Co, 7601 Central, Detroit 8, Mich.

P1077 • LAMP STARTER—This safety starter eliminates danger of fire, short circuits and transformer burn-outs in fluorescent lamp fixtures. Starter is a thermostatic relay switch that prevents repeated starting attemps when lamp is defective. If defective lamp does not light within 30 sec, thermal relay automatically switches off lamp.

Suclar Laboratories Inc, 36 Halsey St, Newark, N.J.

P1078 • AIR DIFFUSER—A modification of the *Kno-Draft* adjustable air diffuser permits its combination with a pendant light fixture so both may be hung from the same spot on the ceiling.

Diffuser retains all its functional features and can be supplied with or without an air volume damper. The angle of air discharge can still be adjusted. Modification may be made on any size or type of diffuser.

W B Connor Engrg Co, 114 E 32nd St, New York 16, N.Y.

P1079 • ARC WELDER—Heavy-duty, 300 and 400-amp sizes, arc welder, the *Yellow Jacket* 36-*A*, has a 40 v dc, NEMA approved, variable voltage generator with simplified current output control.

Unit is a complete 2-bearing unit, engine-driven by sheaves and steel-cored V-belts. The 36-*A* is powered by a 6-cylinder engine, 76 in. long, 28 in. wide and 49 in. long in stationary and portable models.

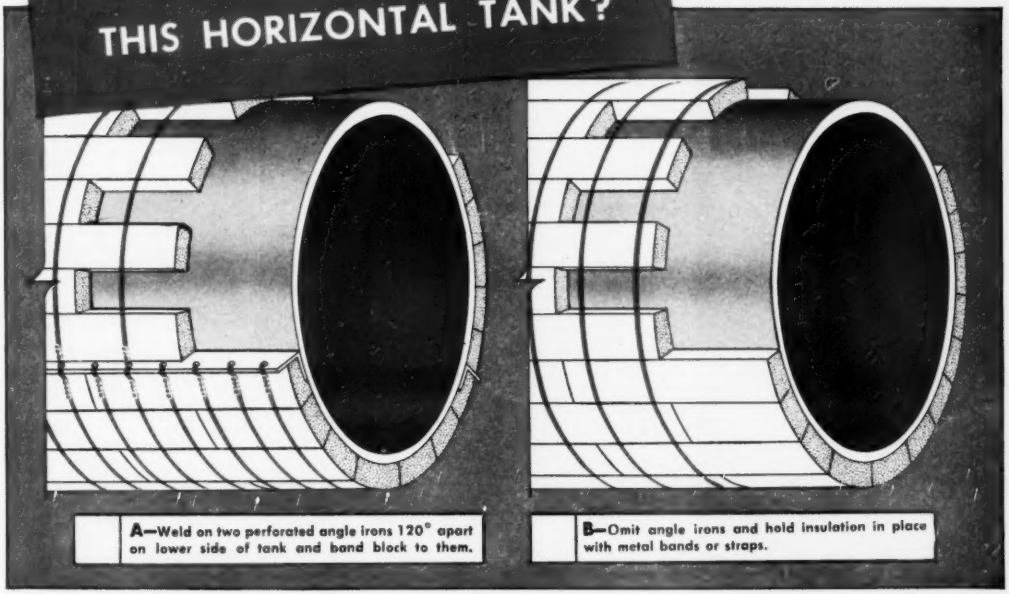
Air Reduction Co, 60 E 42nd St, New York 17, N.Y.

P1080 • CONCRETE FLOAT—Vibrating electro-magnetic concrete float speeds up construction work where low moisture content concrete is used by about five times.

Unit consists of a 15-lb pulsating electro-

HOW WOULD YOU ATTACH HEAT INSULATION TO THIS HORIZONTAL TANK?

● Horizontal tank 6′ in diameter is to be insulated with 2″ thick 85% Magnesia block. Which of the two methods illustrated would you recommend?



A—Weld on two perforated angle irons 120° apart on lower side of tank and band block to them.

B—Omit angle irons and hold insulation in place with metal bands or straps.

HERE'S WHAT THE ARMSTRONG ENGINEER RECOMMENDED:

Both methods shown above will hold the insulation on a 6′ tank firmly in place. But on a tank this size, it is unnecessary to go to the extra expense of welding on and perforating the angle irons. The Armstrong engineer recommended the less expensive Method B.

However, on very large tanks, or where extreme vibration conditions are encountered, it is often necessary to additionally support the bottom third of the insulation. Then Method A, or some other means of providing extra support to the insulation on the underside of the tank, would be in order.

Many times a piece of heated equipment can be efficiently insulated in two or more ways. In these cases, an engineer or workman well grounded in the application of heat insulation can quickly choose the best method.

Armstrong engineers, construction superintendents and foremen are all practical men. If an insulation job presents new or unusual problems, they'll solve them in practical ways. If the choice of several recognized methods is offered, they'll weigh all factors carefully and recommend the most practical one.

The next time you consider having insulation work, take advantage of this practical knowledge of Armstrong's Contract Service. It offers you quality materials, expert engineering, and efficient workmanship.

FREE BOOKLET

Write today for 28-page booklet, "Armstrong's Industrial Insulations." It contains a chart listing types and thicknesses of insulation for all temperatures. Armstrong Cork Co., 7010 Maple Ave., Lancaster, Penna.

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FOR ALL TEMPERATURES FROM 300° F. BELOW ZERO TO 2800° F.

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Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ont., Canada

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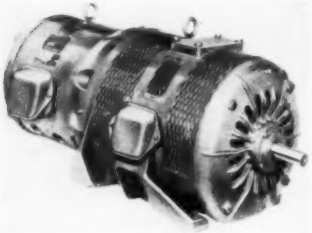
magnet vibrator on a 24 in. by 30 in. steel float. A three section 7½ ft long tubular handle and a 35 ft, 3-conductor grounded cable for 110 v operation completes the assembly. A dial switch in the controller furnished with the unit permits varying float vibration intensity for different degrees of moisture-content in concrete. Intense vibration applies for rough, dry concrete and practically none for finishing.
Syntron Co, 492 Lexington Ave, Homer City, Pa.

P1081 • GREASE ABSORBENT—Low cost removal of grease, oil, kerosene and gasoline from plant floors can be done with *Kwixorb*, a grayish, granular material.

Kwixorb is non-inflammable, chemically inert so it will not burn even when soaked with oil, nor is it affected by acids or alkalis. Just cover the spillings with about ½ in. of the absorbent and rake upper surface underneath at intervals for best results.
Pennsylvania Refining Co, 2686 Lisbon Rd, Cleveland 4, Ohio.



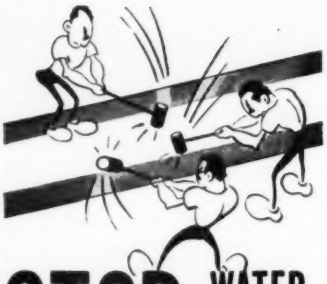
P1082 • VARIABLE-SPEED DRIVE—An ac motor provides variable-speed output with a constant torque characteristic through an eddy-current clutch without usual motor generator set or exciter. Continuous-duty speed ranges as high as 10 to 1 are possible in the smaller sizes; intermittent duty speed range is infinite in all sizes.

It operates directly from a 2- or 3-phase ac line. The drive is suited for driving such equipment as calenders, printing presses, paper and metal slitters, conveyors and other variable-speed machines requiring constant torque input throughout its operating speed range.
Louis Allis Co, 427 E Stewart St, Milwaukee 7, Wis.

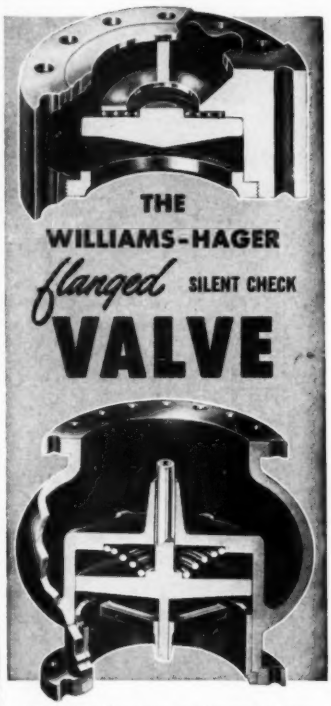
P1027 • NONCORROSIVE PUMP—In *flex-i-liner*, the transferred liquid or gas never touches any of the metal parts. This design makes pump particularly suitable for handling corrosive liquids such as acids, alkalies, industrial alcohols and many corrosive gases.

The fluid flows on outside of *flex-i-liner* and on inside of the body block. *Flex-i-liner* material can be specified in either a pure gum rubber or a synthetic depending on application. Body block can be obtained in plastic or hard rubber. An eccentric rotor mounted on a ball bearing rides inside and activates the *flex-i-liner*. "Squeegee" action thus created is the basis of pump operation.

Unit is of positive displacement type



STOP WATER HAMMER



The Williams-Hager Flanged Silent Check Valve is available for every service . . . bodies of Iron, Semi-Steel, Cast Steel, Government Bronze, Stainless Steel or Monel Metal . . . fitted with seats and discs of either Government Bronze, Stainless Steel or Monel. Standard sizes from 1 inch to 20 inches. *Write for new technical bulletin.*

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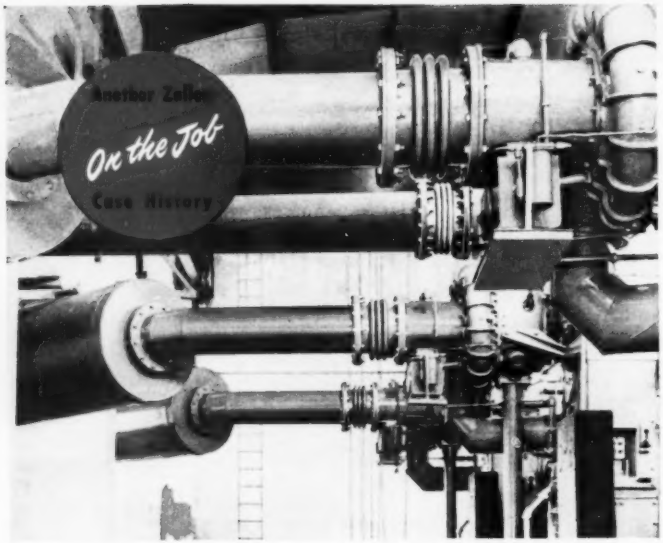

Zallea chosen for Petoskey

WHEN plant equipment was considered for the new municipal Diesel power station at Petoskey, Michigan, Zallea Stainless Steel Expansion Joints were chosen for assurance of dependable, trouble-free service on the Diesel intake and exhaust lines.

Shown here, are four of six 14″ and 16″ Zallea Stainless Steel Expansion Joints, used to absorb expansion in the line between the supercharger nozzle and the silencers as well as the expansion of the air intake lines. These *particular* Zallea Joints require a very low load to compress, affording adequate protection for the fragile supercharger unit itself. Dependability and trouble-free performance are built into *every* Zallea Joint. They *last*, even under the most severe conditions.

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and self-priming. Possibility of external leakage and contamination by oil or grease is avoided by eliminating glands or stuffing boxes. There are no check valves of any sort. *Flex-i-liner* may be replaced without removing lines or attached equipment.

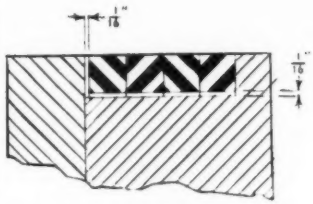
Four models available are: *A*18, 180 gph; *A*12, 120 gph; *A*6, 60 gph; and *A*2, 20 gph. Units may be obtained mounted and direct-connected to ¼-hp ac 1750-rpm motor. Variable-speed, explosion-proof or completely enclosed motors may be supplied.

Vanton Pump Corp, Empire State Bldg, New York, N.Y.

P1042 • METAL PRESERVER — Ensign No. 395 metal preserver, for metals in storage and transit, is said to expel moisture and seal surfaces with a dull-gloss black finish that resists acid, alkali and destructive fumes.

While dry to touch, Ensign No. 395 remains flexible and, therefore, does not crack, check, chip or peel with expansion or contraction of metals in temperatures ranging from 0 to 400 F. It may be applied by brush, spray or dipping. In maintenance applications, Ensign No. 395 may be applied directly to rusted surfaces after loose scale has been brushed off.

Ensign Products Co, 3528 E 76th St, Cleveland, Ohio.



P1028 • PISTON PACKING — *Palmetto Pisto-Ring* packing is designed to meet particular requirements of inside-packed reciprocating-pump service. These advantages are claimed: (1) molded to exact size, easy to install, no special tools or skill required; (2) flexible and resilient, will not crack; (3) impervious to boiler feedwater, salt water, fuel oil, lubricating oil, gasoline, brine, alcohol and most acids and alkalies; (4) heat resistant up to 450 F; (5) self-lubricating.

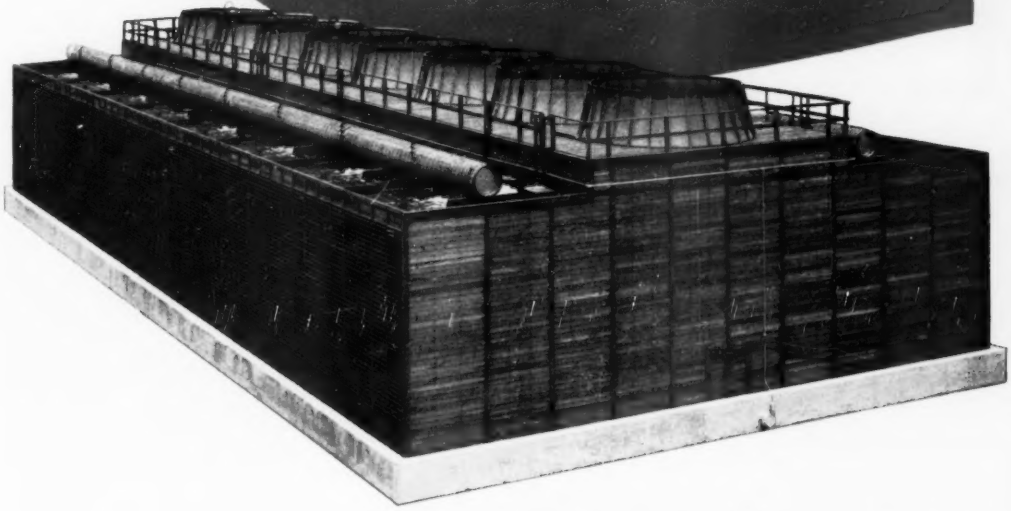
Pisto-Ring packing is available in 16 sizes from 5¼ in. OD and 3¾ in. ID to 14 in. OD and 12½ in. ID. Widths range from 13/32 to ¾ in. Special sizes to specifications are obtainable.

Greene, Tweed & Co, North Wales, Pa.

P1083 • PERSPECTIVE DRAWING — *Perspect-O-Metric* fits any drafting board. It has three scale arms with the central one fixed at right angles to the established base line. The left and right arms pivot in plane of drawing board.

Operation of the *Perspect-O-Metric* is based on the fact that parallel lines seem to converge as they grow more distant. The

control SLIME and ALGAE... SANTOBRITE



Santobrite—Monsanto's Sodium Pentachlorophenate, Technical—offers you these advantages for elimination of slime and algae in cooling water systems:

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6. Readily available at reasonable cost.

Santobrite provides an economical means of maintaining peak efficiency in your cooling operations... For more detailed information, send for a copy of Monsanto Technical Bulletin O-15. MONSANTO CHEMICAL COMPANY, Desk F, Organic Chemicals Division, 1763 South Second Street, St. Louis 4, Mo.

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By removing all traces of residual oxygen, Santosite makes possible economical control of oxygen corrosion in boiler tubes and other steam generating equipment. For detailed information on the Santosite treatment, ask for a copy of Monsanto Technical Bulletin O-26.

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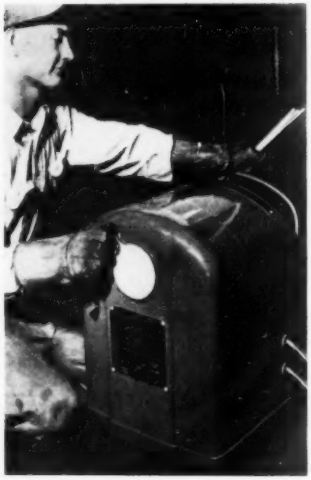
spot at which the lines vanish is the "vanishing point". This attachment provides for two vanishing points that can be located at any position along edges of drawing board. **Charles Bruning Co, 4754 Montrose Ave, Chicago 41, Ill.**

P1015 • ELECTRICAL INSULATION—An insulating plastic film for coils is applied like tape and then heat-treated. It bonds itself into a unified layer of insulation. Usually the film serves without other materials.

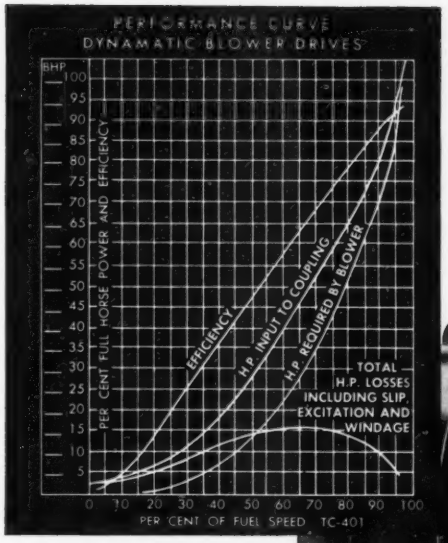
Scotch-Weld film is provided in 60-yd rolls like tape in widths up to 42 in. and in thicknesses of 2, 4, 6 and 8 mils. It is not sticky to the touch. After being wrapped around a coil, film is cured by heat treating 1 to 2 hours at temperatures usually between 200 and 300 F. Dielectric strength varies with degree of heat cure, ranging up to more than 1750 v per mil of thickness on a fully cured film.
Minnesota Mining and Mfg Co, 900 Fauquier St, St. Paul 6, Minn.



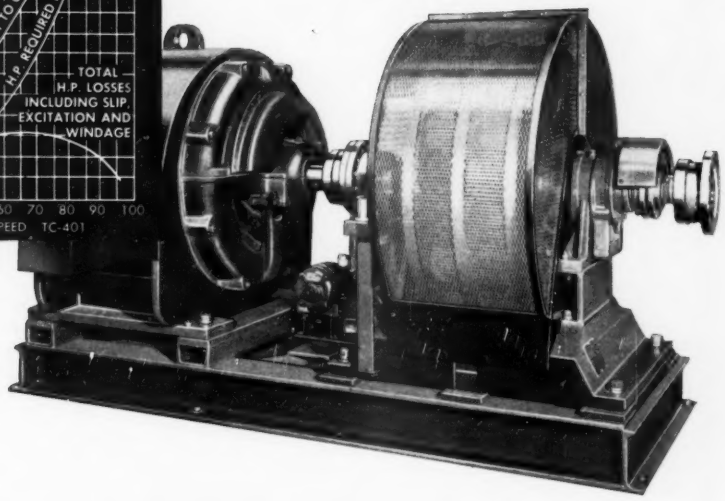
P1049 • ARC WELDER—*Fleetwelder* 200 is suited for ac job-shop and industrial welding. It uses electrodes ranging in size from 5/64 to ¼ in. Total weight is 319 lb.

Low-current welding of thin sheets is simplified and high-current welding of heavy plate is made faster through the *Arc Booster*, which adjusts the welder to start the arc automatically the instant electrode touches the work. Current automatically returns to correct amount set for the job after a few seconds. The heavy copper windings are insulated with spun glass and mica separators and placed in a welded steel-laminated frame.
Lincoln Electric Co, Cleveland 1, Ohio.

P1012 • GOVERNOR — Micro-switch centrifugal governor turns off motor, engine or other electrically energized equipment when a predetermined speed limit has been exceeded. Unit is designed for service where investigation or corrective



EATON DYNAMATIC BLOWER DRIVES



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The performance curve above indicates the characteristics of Dynamatic couplings when driving fans or blowers. Fundamentally, all fans and blowers will have curves very close to the ideal curves shown in this figure. Note the desirable relationship between efficiency, horsepower input, and required horsepower. The horsepower losses indicated are normal for this type of application. Both air cooled and water cooled types of Dynamatic couplings are available, selection depending upon loads and type of service involved. The electric-slip coupling was developed and introduced by Dynamatic; this company has pioneered the use of electric-slip couplings in fan and blower drive applications. Write for illustrated literature.

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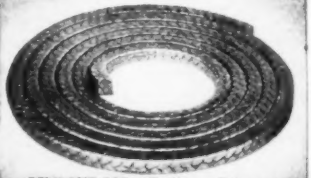

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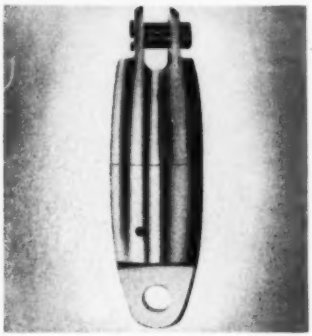
measures must be taken before "runaway" equipment is put back in operation.

Typical use is a motor-driven pump operating under constant load. Leakage in system increases motor speed which, at a predetermined point, causes governor to break electrical circuit to pump motor. Micro-switch must be reset manually before motor can be restarted.

Pierce Governor Co, 962 Sixth St, Anderson, Ind.



P1031 • WIRE-ROPE SWIVEL — Double roller bearings permit swiveling under full load in unit now offered for all rope applications.

Some features are: both thrust and radial roller bearings; completely streamlined bodies; heavy load capacity in relation to size; permanent lubrication; replaceable parts. Swivels are offered in five sizes: for ½, ⅝, ¾, 1 and 1½ in. wire rope. They can be had with four types of ends: eyebolt, hook-bolt, integral eye or clevis.

Flexo Machines Co, 456 N Aberdeen St, Chicago 22, Ill.

P1038 • PISTON RINGS — Stainless steel, which maintains tension under excessive temperatures and is corrosion resistant, is employed in new series of "nonbreakable" piston rings.

In addition to being free from distortion, the rings are said to reduce friction and wear by providing a "dissimilar" metal for the rubbing surfaces and to increase compression efficiency by a near-constant expansion factor that permits closer tolerances between ring and cylinder wall. All rings are ground on the OD and are lapped on the sides to provide perfect seating and eliminate sloppiness in the piston grooves.

Steel or Bronze Piston Ring Corp, Indianapolis, Ind.

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BOILERS AND AUXILIARIES

B11 **SPREADER STOKER**—American Engrg Co, Cumberland and Aramingo Ave, Philadelphia 25, Pa. 14-page catalog, entitled "AE Perfect Spread Stoker," discusses construction, operation and advantages of this type stoker. Also illustrates typical installations under a variety of boilers.

B12 **WORM-FEED STOKER**—Brownell Co, 306 N Findlay St, Dayton 1, Ohio. 8-page brochure No. S-41 contains complete description and data on Type F worm-feed stoker. Construction details are shown.

B13 **INDUSTRIAL OIL-BURNING SYSTEMS**—Simplex Oil Heating Corp, 11 Park Pl, New York 7, N. Y. 4-page booklet No. 133-41 cites advantages of Simplex oil-burning systems.

B14 **MULTIPLE DOUBLE-RETORT STOKER** — Detroit Stoker Co, General Motors Bldg, Detroit 2, Mich. Bulletin describes multiple-retort wide-cleaning stoker for large boilers.

CONTROLS, MECHANICAL

E5 **PRESSURE REGULATORS** — Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. 32-page catalog No. 5 covers complete line of pressure regulators. Illustrations of 26 regulators and a section on regulator adapters and pressure gages are included. Also, flow and pressure charts are given.

E6 **GOVERNOR CONTROL** — Meriam Instrument Co, 10920 Madison Ave, Cleveland 2, Ohio. 4-page folder No. 1000 features Wallene governor control. Informative data contain function, applications and graphs.

ELECTRICAL EQUIPMENT

F11 **UNIT-COOLED DC MOTORS** — General Electric Co, Schenectady 5, N. Y. 4-page booklet No. GEA-4469A tells about GE unit-cooled dc motors, Type CD, 15 to 200 hp, constant or adjustable speed, for dusty, dirty or oil-laden atmospheres.

F12 **HORIZONTAL MOTOR** — U. S. Electrical Motors, Inc, 200 E Slauson Ave, Los Angeles 54, Calif. 8-page brochure No. 1834 presents U. S. Unicloset motor in ratings from ½ to 250 hp. Special features are described and illustrated in detail.

F13 **AIR-COOLED TRANSFORMERS** —Standard Transformer Co, Warren, Ohio. Bulletin No. S-303A presents Class A and B insulated dry-type air-cooled transformers. Weights, dimensions and full technical data are included.

F14 **FUSE DATA**—S & C Electric Co, Dept P, 4435 Ravenswood Ave, Chicago 40, Ill. An all-in-one package of Time-Current information for power fuse coordination. 60 pages of curve sheets and engineering data are filed in separate, indexed folders for each fuse line.

F15 **BATTERY CHARGER** — Electric Products Co, 1725 Clarkstone Rd, Cleveland 12, Ohio. 4-page folder No. 235 describes newly designed, 4-circuit battery charger for servicing motorized hand-lift trucks.

F16 **COMMUTATOR AND SLIPRING MAINTENANCE**—Ideal Industries Inc, Sycamore, Ill. 40-page handbook of procedures and methods on commutator and slipring maintenance.

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POWER, 330 West 42nd St., New York 18, N. Y. 10/49

F17 **VARIABLE-SPEED AC MOTOR**—Louis Allis Co, 427 E Stewart St, Milwaukee 7, Wis. 14-page bulletin No. 611-D gives informative data on Louis Allis' Adjusto-Speed, an ac variable-speed drive. Features are illustrated and described in detail.

MAINTENANCE AND SAFETY EQUIPMENT

K3 **TUBE EXPANDERS**—Thomas C Wilson Inc, 21-11 44th Ave, Long Island City 1, N. Y. 6-page catalog No. 630 consists of Wilson-Dudgeon tube expanders for condensers, heat exchangers and general small-tube rolling.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **FIRE-PREVENTION GUIDE**—Protectoseal Co, 1930 S Western Ave, Chicago 8, Ill. 12-page booklet, entitled "Flammables, Self-Checking Chart," outlines procedures to be followed in helping industry reduce hazard of and loss by fire. Also contains several departmental charts that help to make an accurate check-up on flammable hazards.

K4 **POWER TOOLS** — Beaver Pipe Tools Inc, 349-749 Dana Ave, Warren, Ohio. 36-page brochure No. 49 lists a complete line of hand and electric power tools for cutting and threading pipe, bolts and conduit.

MAINTENANCE MATERIALS

L12 **SLUDGE REMOVER** — Alken-Murray Corp, 121 E 23rd St, New York 10, N. Y. Folder, entitled "Beware of Sludgey," explains how to prevent water and impurities in fuel oil from forming sludge, which clogs burner nozzles, oil lines, etc, and prevents burners from functioning properly.

L13 **CLEANING INDUSTRIAL EQUIPMENT**—Dowell Inc, Kennedy Bldg, Tulsa 3, Okla. A general information bulletin on Dowell's service for cleaning steam generating, heat exchange and other industrial equipment. Also includes pipeline cleaning and waterwall acidizing.

L14 **CONCRETE WORK**—Gunite Concrete & Construction Co, 1301 Woodswether Rd, Kansas City 6, Mo. 36-page catalog No. 10 points out physical characteristics, adaptability, application and advantages of Gunite concrete work. Typical jobs are illustrated.

L15 **CHEMICALLY INERT PACKING**—Crane Packing Co, 1800 Cuyler Ave, Chicago 13, Ill. 8-page booklet No. SP-5M649 covers applications and features of John Crane Chemlon, a chemically inert packing.

L16 **SHIMS, LOCKNUTS**—Laminated Shim Co, 71 Union St, Glenbrook, Conn. 2-page data file gives specifications, design factors and applications of company's shims, locknuts and stampings.

L17 **RUBBER AND ASBESTOS PRODUCTS**—Manhattan Rubber Div, Raybestos-Manhattan Inc, Passaic, N. J. 16-page leaflet No. 6902 describes rubber and asbestos products for the petroleum industry. Principal R-M products for oil production, refining, transporting and maintenance are also covered.

L18 **ANTI-RUST PAINT**—Speco Inc, 7308 Associate Ave, Cleveland 9, Ohio. Sheet No. 10M-5-49 contains price schedule and specification list for Rustrem, an anti-rust paint.

L19 **SCALE REMOVAL** — Alken-Murray Corp, 121 E 23rd St, New York 10, N. Y. 4-page folder on Scaloff discusses scale formation and prevention in boilers. Photos and diagrams are included.

L20 **CORROSION-RESISTANT RESINS**—Carboline Co, 7603 Forsyth Blvd, St. Louis 5, Mo. 4-page leaflet No. C-3 tells how to resurface and repair rubber-lined and hard-rubber equipment for corrosive service.

MATERIALS HANDLING

M10 **ELEVATOR INDICATOR UNIT**—Otis Elevator Co, 260 Eleventh Ave, New York 1, N. Y. 4-page bulletin No. B-2065-9450 describes operation of indicator unit on the Autotronic indicator and control panel. Illustrated examples are shown.

M11 **FLYASH PUMP** — Fuller Co, Catasauqua, Pa. 4-page brochure No. F-K-16 features the Fuller-Kinyon pump for conveying dry flyash from collectors to storage bins.

MECHANICAL TRANSMISSION

N8 **MULTIPLE V-BELT** — Worthington Pump & Machy Corp, P O Box 955, Buffalo 5, N. Y. 8-page booklet No. V-1400-B18 introduces Vee-Ply, a quickly detachable V-belt designed for service emergency breakdowns. Selection charts and hp ratings are given.

N9 **FLEXIBLE CHAIN COUPLINGS**—Morse Chain Co, 7601 Central, Detroit 8, Mich. 16-page catalog No. C45-49 lists roller-chain stock couplings; silent-chain stock couplings; heavy duty, made-to-order silent-chain couplings; and steel and plastic covers for the two stock couplings.

N10 **TRANSMISSION BELTING** — U. S. Rubber Co, Rockefeller Center, New York 20, N. Y. 32-page bulletin No. M-9923 gives detailed design, engineering and performance data for the company's line of transmission belting. Tables on belt speeds, arc of contact, friction, and service factors are included.

METALS AND ALLOYS

R6 **MAGNESIUM ANODE DATA**—Dowell Inc, Kennedy Bldg, Tulsa 3, Okla. 5 sheets of general information on magnesium anodes for cathodic protection of industrial equipment subject to corrosion. Prices are given.

R7 **GRID CASTING** — Gould Storage Battery Corp, Trenton 7, N. J. 6-page reprint, entitled "New Grid Casting Improves Battery Life," contains informative data on research in both mechanical design and techniques of soft-metal casting that produce a new type of lead grid for supporting the active oxides in the positive plates of lead-acid storage batteries.

(*Continued on page 188*)

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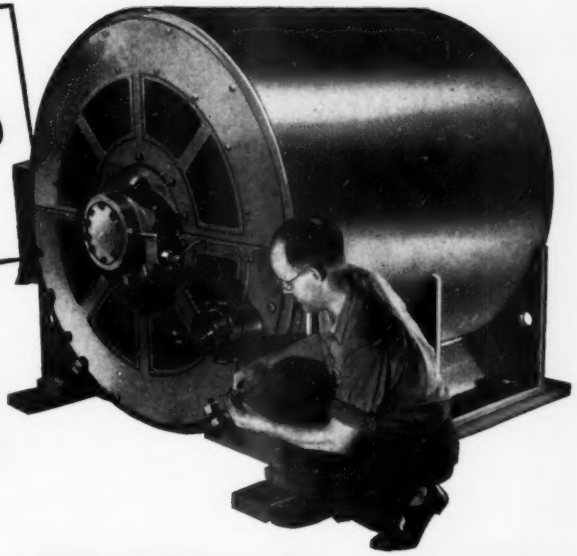
TUBE-TYPE TOTALLY-ENCLOSED FAN-COOLED MOTORS!

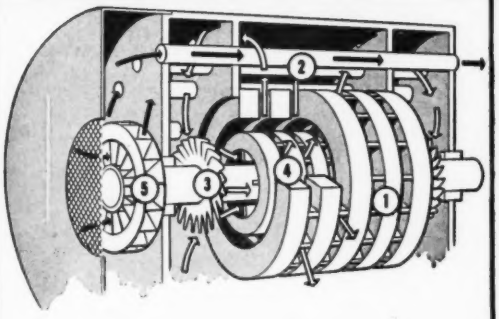


DIRT-

AND CORROSION-RESISTANT!

PROOF!

How Tube Cooling Works



Stator core (1) is surrounded by tubes (2). Internal fans (3) circulate air through ducts (4) in rotor and stator and around tubes, transferring heat to tubes.

External fan (5) drives outside air through tubes, removing heat and keeping tubes clean. All electrical parts are enclosed. Dirt cannot enter.

*Totally-Enclosed Fan Cooled

- **Install anywhere – indoors or out**
- **Heat exchanger is practically *self-cleaning***
- **Sizes . . . 75 to several thousand horsepower**

THIS ALLIS-CHALMERS tube-type TEFC* motor practically eliminates cleaning and other high maintenance costs associated with large motors exposed to dirty and corrosive atmospheres. And it does this with a simple, self-contained, tube-type, ventilating system.

All electrical parts — including the stator core — are enclosed. The simple heat transfer system keeps temperatures well within rated limits. Cleaning is rarely needed because air passages are unrestricted. Air flow through the straight tubes removes foreign matter.

Three years of field operation have proved important savings. Sizes from 75 hp and up. Also explosion-proof designs. For complete information, outline your requirements to your A-C Sales Office, or write for Bulletins 05B7150 and 51R7149.

A 2664

ALLIS-CHALMERS, 951A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

For GREATEST
DEPENDABILITY and EFFICIENCY
in metered pressure pumping of
SULPHURIC ACID
...at all concentrations

Here is the equipment which will handle sulphuric acid, in all concentrations, performing the dual function of taking the acid from atmosphere pressure to line pressure, and metering or proportioning its flow. Because the Pulsafeeder has no stuffing box—but uses instead an hydraulically-balanced diaphragm seal, it eliminates leakage, prevents corrosion of pump or contamination of product, avoids loss of prime—all at lowest possible maintenance. Hundreds of satfactory installations to back up these claims!

- NO STUFFING BOX OR RUNNING SEAL
- HYDRAULICALLY-BALANCED DIAPHRAGM SEAL
- POSITIVE DISPLACEMENT PISTON MEASUREMENT
- FLOW RATE ADJUSTABLE WHILE IN OPERATION
- OIL-BATH LUBRICATION OF ALL MOVING PARTS
- UNITS AVAILABLE FOR MANUAL OR AUTOMATIC CONTROL

Lapp
PULSAFEEDER
PISTON-DIAPHRAGM CHEMICAL PROPORTIONING PUMP

WRITE for Bulletin 262 with complete description and specifications.
LAPP INSULATOR CO., INC., PROCESS EQUIPMENT DIVISION, 159 MAPLE STREET, LE ROY, N. Y.

R8 **CORROSION-RESISTING SHEET AND PLATE**—Durlron Co, Inc, Dayton 1, Ohio. 8-page leaflet No. 502 describes Durimet 20, corrosion-resisting sheet and plate. Installation photos and lists are included.

R9 **HEAVY-DUTY BABBITT**—Magnolia Metal Co, Elizabeth 4, N. J. Single-sheet presents the company's new DZL heavy-duty, genuine babbitt for sleeve bearings subject to combined weight, heat and shock.

METERS AND INSTRUMENTS, MECHANICAL

T10 **DIAL THERMOMETERS**—Powers Regulator Co, 2720 Greenview Ave, Chicago 14, Ill. Bulletin No. 355 features vapor-pressure-actuated dial thermometers. Available with rigid stem for use in pipelines and tanks, or flexible-tubing type for ascertaining temperature at a point some distance from the dial.

T11 **LIQUID-LEVEL GAGE** — Vapor Recovery Systems Co, P O Box 231, Compton, Calif. 8-page booklet covers operation and construction of the Varec electronic gager. Diagrammatic installations are included.

T12 **PRESSURE GAGES** — Helicoid Gage Div, American Chain & Cable Co, Bridgeport 2, Conn. 16-page catalog No. DH-818 explains how the Helicoid gage operates and familiarizes users with the various parts. Also shows large cutaway views.

T13 **LIQUID-LEVEL GAGE**—Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass. Sheet No. 120 tells about new Jerguson Truscale distance-reading gage for liquid-level indication of water in boilers, deaerating tanks, etc.

T14 **RECORDING THERMOMETER**—Bristol Co, Waterbury 91, Conn. Bulletin No. T842 relates the use of the company's traveling-oven recording thermometer to record finishing, lacquering, japanning, drying and baking temperatures. Also contains complete specifications and prices.

T15 **INSTRUMENT CATALOG**—H-B Instrument Co, 2633 Trenton Ave, Philadelphia 25, Pa. 40-page catalog No. 15 describes and illustrates industrial thermometers, psychrometers, thermoregulators, mercury-plunger relays, hydrometers. A simplified price list is included.

PIPING, FITTINGS, VALVES AND SPECIALTIES

U11 **BYPASS AND CONTROL VALVE**—Belfield Valve Div, Minneapolis-Honeywell Regulator Co, Philadelphia 44, Pa. 4-page folder No. 254-1 discusses operation and construction of Schaefer bypass for traps, valves and other pressure units, as well as the union bonnet type for general marine service. 4-page folder No. 350-1 offers dimensions and operating data on Belfield "on-off" air-operated diaphragm-control valve.

U12 **GAGE AND VALVE SETS**—Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass. Single-sheet No. 118 presents diagrams of various combinations of Jerguson gage and valve sets.

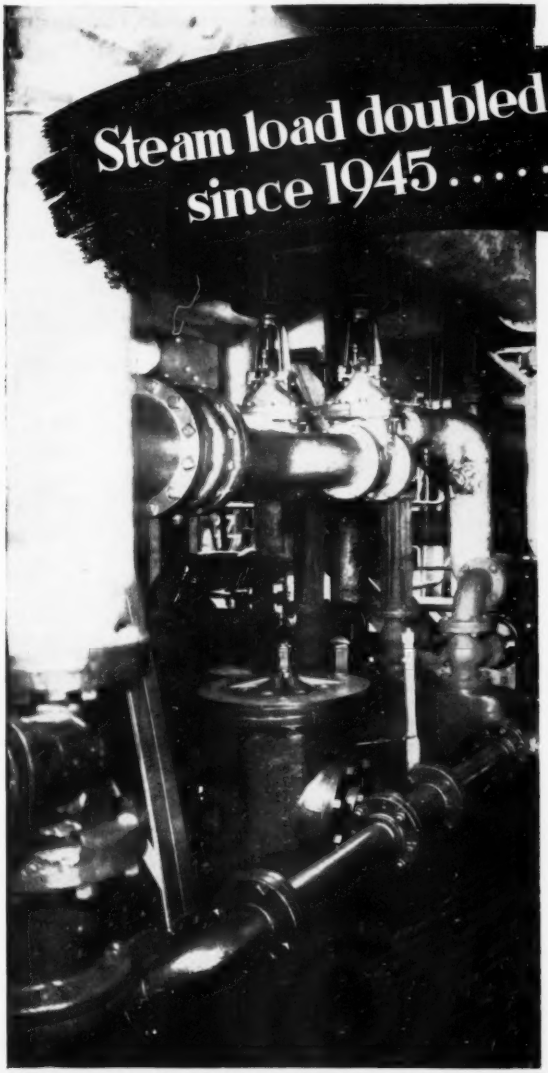
U13 **SLEEVE VALVE**—Coen Co, 40 Boardman Pl, San Francisco 3, Calif. Bulletin No. 90 cites advantages and construction of the Coen sleeve valve. Water-flow chart is included.

U14 **COCKS**—Belfied Valve Div, Minneapolis-Honeywell Regulator Co, Philadelphia 44, Pa. 24-page booklet No. 100-1 covers the Belfield line of extra-grade cocks. Illustrations, sectional drawings and descriptions are given.

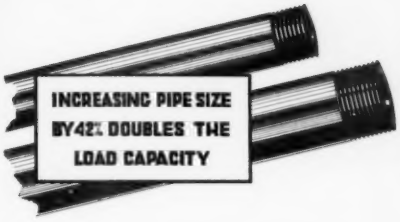
U15 **GAGES AND VALVES**—Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass. 4-page folder No. 119 consists of optional features and accessories for Jerguson gages and valves.

U16 **DUPLEX STRAINER**—Coen Co, 40 Boardman Pl, San Francisco 3,

INSTALL STEEL PIPING ADEQUATE FOR TOMORROW'S NEEDS



Steam load doubled since 1945 . . . . . "oversize" piping is still adequate



YOU'D think doubling the load would call for extensive--and expensive --plant alterations, including replacement of pipe, valves, fittings, etc. But this was an engineer gifted with foresight. In the reconversion of 1945, he "oversized" his pipe all the way along, 40% to 50% bigger than "will do." He was preparing for what did happen.

Of course, there is a point in this for today's construction work: Looking ahead, with steadily increasing loads very much in prospect, isn't it cheaper and smarter to pay extra and put in, for example, a 3-inch steel pipe instead of two-inch today, rather than figure on getting by with two-inch now and when necessary, rip it out to install 3-inch in a couple of years?

A few dollars' worth of foresight today is worth more than a fortune in hindsight tomorrow--especially when it comes to anything so permanent as good steel pipe.

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Pipe and Tubular Products · Sheets · Plates · Electrolytic Tin Plate · Coke Tin Plate · Conduit · Bars · Rods · Wire · Cold Drawn Carbon Steel Rounds · Tie Plates and Spikes

SAVE COOLING WATER

Get Many Other Benefits and Cost Savings

● Niagara Aero Heat Exchangers provide faster and more accurate cooling to specified temperatures for liquids in many industrial processes. They help lower production costs.

Cooling by the evaporative principle, they transfer heat to air, which is easily disposed of, and consume less than 5% of water used in conventional cooling methods. A Niagara Aero Heat Exchanger replaces both shell-and-tube cooler and cooling tower, and saves piping and pumping. Its savings quickly return its cost.

It helps improve the quality of production by removing heat at the rate of in-put, and by greater accuracy of control. For example, as applied to heat-treat quenching or to a chemical process cooling, provision for heating as well as cooling saves the time and prevents the product losses of a "warm-up" period.

Successful applications also include control of temperatures for jacket coolants for engines, hydraulic equipment, transformers and electronic sets, and special industrial equipment.

Write for Bulletin No. 96

NIAGARA BLOWER COMPANY

Over 35 Years of Service in Industrial Air Engineering

Dept. P, 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities

INDUSTRIAL COOLING • HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Calif. Bulletin No. 28 describes the Coen safety strainer for high-pressure, high-temperature service.

PRIME MOVERS AND ACCESSORIES

V1 JACKET-WATER COOLERS — Young Radiator Co, Racine, Wis. 16-page catalog No. 1349 covers complete line of Young jacket-water coolers for gas-, gasoline-, and diesel-engine cooling.

V2 STANDBY POWER PLANTS—Kato Engrg Co, Mankato, Minn. Form No. 449-SB features the Katolight air-cooled power plants designed for standby or emergency service.

PUMPS

W10 ROTARY-PISTON, POSITIVE-DISPLACEMENT PUMPS—Yale & Towne Mfg Co, Stamford, Conn. 6-page brochure No. 4021-48-70 contains informative data, operating charts and installation drawings of 80-B series rotary - piston, positive - displacement pumps.

W11 POSITIVE - DISPLACEMENT PUMP—Milton Roy Co, 1200 E Mermaid Lane, Philadelphia 18, Pa. 4-page leaflet No. 649 tells about Constametric, a positive-displacement, controlled-volume chemical pump having a constant-flow delivery without pulsation. Engineering data and diagrams are included.

W12 SANITARY PUMP — Yale & Towne Mfg Co, Stamford, Conn. 12-page booklet covers Models S40A, S40AV, S40AM and S40AVM Tri-Rotor sanitary pump. Features, curve charts, weights and price list are given.

W13 CONTROLLED - VOLUME PUMPS—Milton Roy Co, 1300 E Mermaid Lane, Philadelphia 18, Pa. 4-page folder No. 499 discusses Milton Roy controlled-volume pumps for chemical service. Applications, features and advantages are stated.

WATER TREATMENT

X3 CHLORINIZER — Builders-Providence Inc, 14 Codding St, Providence 1, R. I. Bulletin No. 840-F3T presents the gravimetric chlorinizer, Model CGS, which meters and feeds gaseous chlorine by the loss-in-weight principle.

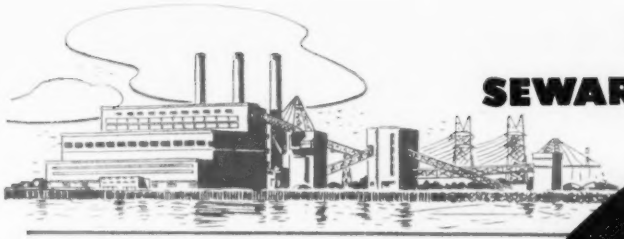
X4 WATER ANALYSES—W H & L D Betz, Gillingham and Worth Sts, Philadelphia 24, Pa. 16-page booklet, entitled "Testing and Control Equipment for Water Analyses," illustrates and describes a complete line of apparatus and test sets especially designed for industrial water testing.

OTHER EQUIPMENT

Z11 PORTABLE MULTI-CIRCUIT PYROMETER—Illinois Testing Laboratories Inc, 420 N LaSalle St, Chicago 10, Ill. Single-sheet gives information on the company's Alnor Type 1200 portable multi-circuit pyrometer. Price list is included.

Z12 VERTICAL TUBULAR HEATER —Foster Wheeler Corp, 165 Broadway, New York 6, N. Y. 4-page bulletin No. 0-49-7 gives complete description of Foster Wheeler simplified vertical tubular heater, which features the use of bare tubes and the absence of any metal parts exposed to furnace gases.

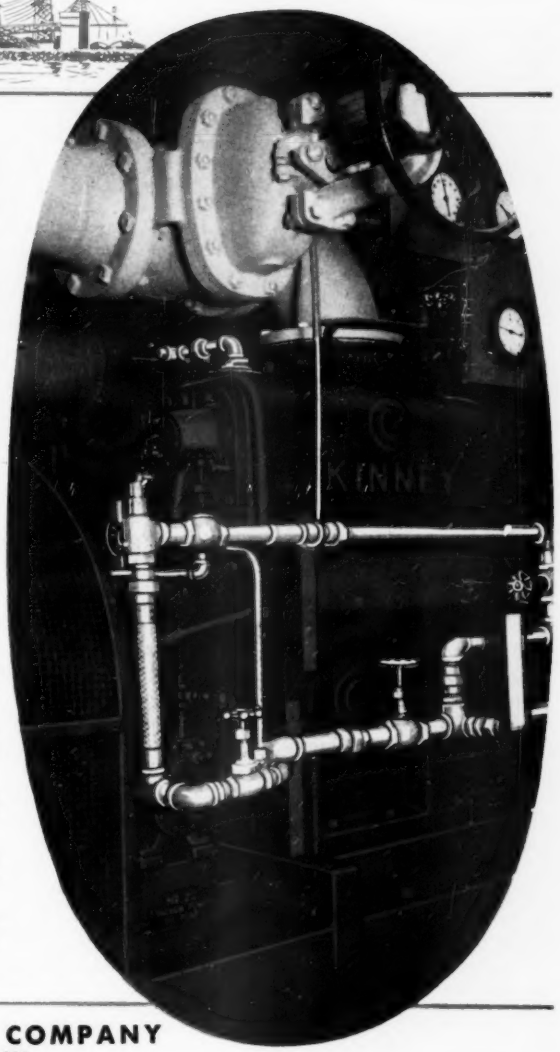
Louisiana Power & Light Co will soon start construction of a new $9,000,000 generating plant at Nine-Mile Point, New Orleans. The first 66,000-kw unit is expected to go into operation early in 1951. Three other units will eventually be installed to bring the plant investment to more than $36,000,000, according to President W O Turner.



SEWAREN SHOWS THE WAY

Most Modern Power Plant uses KINNEY Mechanical Vacuum Pumps —Eliminates "Hogging Jets"—Shows Way to New Operating Efficiency...

Kinney Vacuum Pumps contribute to the outstanding efficiency of the new Sewaren Generating Station — the last word in power plants. After conclusive tests in high pressure, high temperature, steam plants, these Vacuum Pumps were selected for their dependability, economy, and automatic control. The Kinney Vacuum Pumps at Sewaren point the way to new standards in power plant operation. Write for Brochure "Use of Mechanical Vacuum Pumps in Central Station Operation" and Bulletin V-45.



IMPORTANT KINNEY PUMP ADVANTAGES

No Boiler Water Contamination — Kinney Vacuum Pumps remove caustic gas . . . eliminate possibility of ammonia gas concentrations.

Eliminate "Hogging Jets" — Kinney Vacuum Pumps have ample capacity both for normal air removal and for pumping down the unit when starting up.

Automatic Push Button Control — Kinney Vacuum Pumps permit remote control of condenser vacuum from a central control panel.

No Troublesome Reducing Valves — Kinney Vacuum Pumps simplify auxiliary steam lines and piping layouts — banish reducing valve problems.

No Wastage of Condensate — Kinney Vacuum Pumps conserve boiler water — there is no contaminated condensate to discharge to waste.

KINNEY MANUFACTURING COMPANY

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Making Old Things BETTER
Making New Things POSSIBLE

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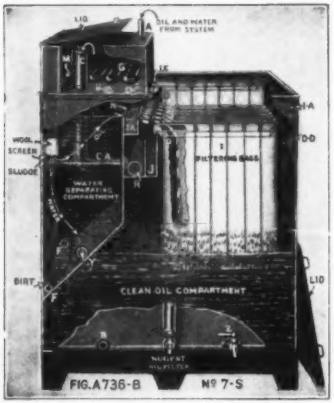
HORROCKS, ROXBURGH PTY., LTD. . . . . Melbourne, C. 1. Australia
W. S. THOMAS & TAYLOR PTY., LTD. . . . . Johannesburg, Union of South Africa
NOVELECTRIC, LTD. . . . . Zurich, Switzerland

KINNEY HIGH VACUUM PUMPS

Maintenance Down . . . Savings Up . . .

When you use NUGENT GRAVITY OIL FILTERS for turbine systems



Nugent Gravity Oil Filters are the economical method of handling filtering problems in large stationary installations. Experience shows that average oil savings are in excess of 95%. And by assuring a continuous supply of CLEAN oil, maintenance is reduced and equipment life extended substantially. For protection against corrosion Nugent Filters neutralize acidity and maintain a safe value. For economy's sake you can't afford to be without a Nugent Oil Filter.

Nugent Gravity Oil Filters may be operated continuously since each of the multiple filtering units can be removed independently for cleaning. And for further convenience an alarm is given automatically when cleaning is necessary. Write for full details today.

Wm. W. Nugent & Co., Inc.
402 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

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POWER NEWS

(*Continued from page 128*)

already has achieved low-cost production.

As designed and built, the new experimental refinery is the minimum size that will provide desired information about shale-oil refining, including operating characteristics and costs.

Capitol May Buy Electricity From Potomac Electric Power

After appropriating millions for federal power plants elsewhere, the 81st Congress may soon vote to get the government out of the generating business in Washington, D. C.

A group of engineers, on the job for the past three years, has recommended abandonment of power generation in the 39-yr-old Capitol power plant. Instead, they urged that electricity for the Capitol and surrounding federal buildings be purchased from Potomac Electric Power Co. A refurbished Capitol power plant would continue to supply steam heat and air conditioning for the Capitol, the House and Senate office buildings, and several other nearby federal offices.

A House commission, headed by Speaker Sam Rayburn, is expected to endorse these plans, which already have the approval of Capitol Architect David Lynn. Besides abandoning the generating plant, the program calls for modernizing the Capitol's lighting and wiring, and improving and extending the heating and air-conditioning systems at a total estimated cost of $16,440,000.

The engineers estimated that the Capitol's electric power could be purchased from PEPCO at an annual cost of about $359,000, on which the company would pay taxes of about $35,000. The government is paying three times as much, it was reported, to get its power from two 25-cycle ac generating units.

More than half the energy produced by these decrepit machines must be converted to dc for lighting and to operate motors, the engineers found. This has resulted in a conversion loss of some 25%, or about 5 million kwhr per yr. In addition, it has been necessary to purchase conversion equipment for most of the office machines in the area supplied by the existing plant.

The engineers recommended recycling of the distribution system and complete rewiring of the buildings at an estimated cost of $7,600,000. To avoid serious interruption of business in the buildings, the program would be carried out piecemeal over a 4-yr period. PEPCO would be asked to supply about a third of the peak load, or about 4000 kwhr initially.

H K Porter Co, Pittsburgh, Pa., has completed its acquisition of Jarecki Mfg Co. of Erie, Pa. Jarecki Mfg Co remains under its own name at Erie. Founded in 1852, Jarecki manufactures a broad line of valves and fittings, and operates 27 stores in the mid-continent oil fields.

R/M
rubber sheet packings

Whatever your requirements for rubber sheet packings, you will find one of the many R/M sheets is made to order for your needs.

R/M makes a diversified line of rubber and asbestos sheets, covering a wide range of applications and prices. All are made to the highest standards of quality.

R/M Style No. 625 Red Rubber Sheet Packing is a tough, long-lasting, resilient sheet, recommended for use in air, water, and steam at pressures up to 150 pounds per square inch.

R/M Style No. 635 Rubber C. I. Sheet Packing is a resilient Flexlastic sheet with one ply of cloth for every 1/16th inch of thickness. It is recommended for cold water and low pressure service.

R/M Style No. 645 Diaphragm Sheet is of high-tensile, square-woven duck, covered with best grade Flexlastic. It is widely used in water, oil, air, and gas damper regulators.

For reliability, for long and satisfactory service, consult your R/M Packing Distributor. All R/M packings and gaskets for maintenance are sold only through authorized R/M distributors.

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

Factories:
Bridgeport, Conn.; Manheim, Pa.;
No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Fan Belts • Radiator Hose • Powdered Metal Products • Bowling Balls

PLAY SAFE ...
specify CATAWISSA

there is a difference!

NEW PLANT OR OLD...

Catawissa UNION and VALVE dependability means LOWER MAINTENANCE COSTS ... with an EXTRA margin of safety!

HOT FORGED STEEL
AND
STAINLESS STEEL
UNIONS

STANDARD
1/8" TO 3"
Cold-Working Pressure up to 2,000 pounds.

DOUBLE EXTRA HEAVY
1/8" TO 2"
Cold-Working Pressure up to 6,000 pounds.

The Catawissa seat design gives you a perfect seal for every installation -- even when the pipe is not properly aligned -- with its 55-degree angle on the female end to a ball on the male end!

HOT FORGED STEEL SWING CHECK VALVES
ESPECIALLY ADAPTED FOR HIGH TEMPERATURE & HIGH PRESSURE SERVICE!
For boiler injection--engineered to outlast the boiler! Efficient, easily accessible!

See your industrial supply distributor -- or write direct for a copy of BULLETIN 10-A

CATAWISSA VALVE & FITTINGS COMPANY
206 Mill Street
CATAWISSA, PENNA.

CATAWISSA
UNIONS ★ VALVES

DEMA Elects Robert S Ogg Educational Director

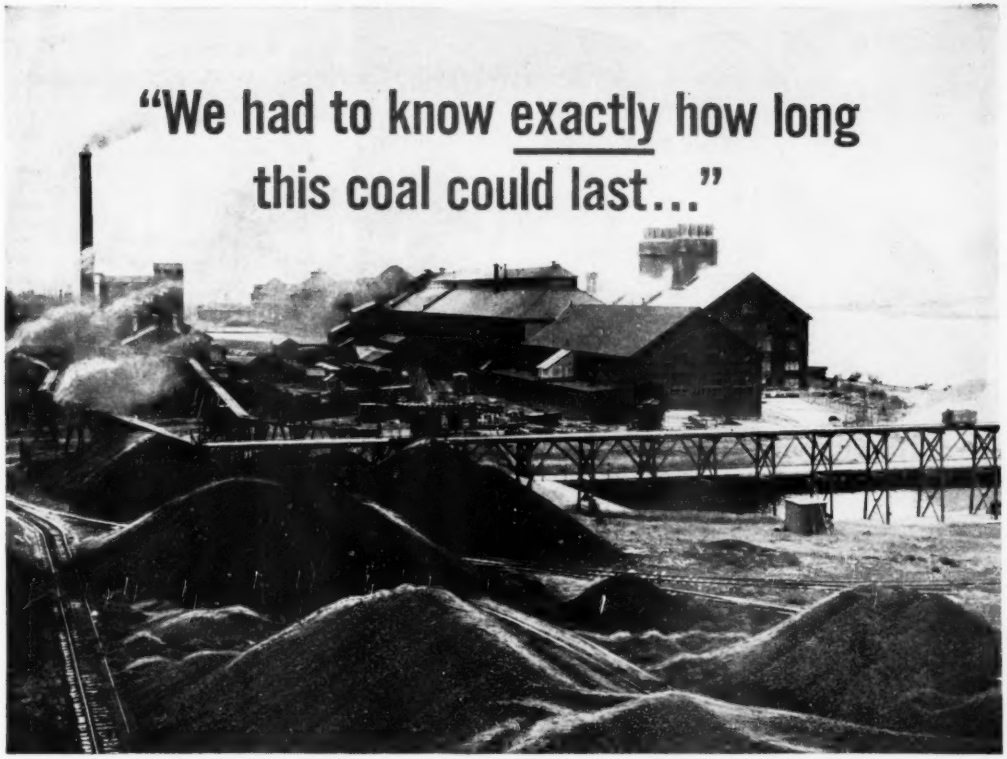
Robert S Ogg is now educational director of Diesel Engine Manufacturers Assn. Ervin L Dahlund resigned from this position on June 1 to become chief engineer of the diesel engine div of Fairbanks, Morse & Co, at Beloit, Wis.

Ogg joins the DEMA staff from the Lima-Hamilton Corp, Hamilton, Ohio, where he has been employed for a number of years in their engineering dept. A large part of his time will be spent with the accredited mechanical engineering schools of the country. The rest will be with the engineering departments of the diesel engine builders and the 41 manufacturers of parts, accessories and oils for diesel engines that are assisting with this educational program.

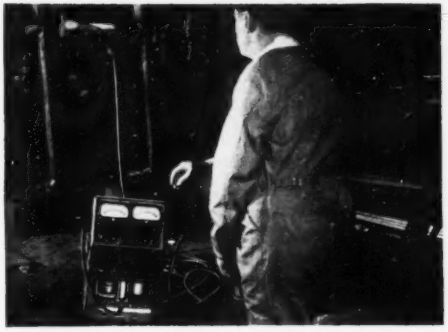
DEMA's educational program is unique in that it is an industry's cooperative effort to help the mechanical engineering schools of the country produce better graduate engineers for jobs in the diesel-engine industry. With this is coming a better understanding by all mechanical engineering graduates as to where diesel engines belong and where they do not belong.

Baldwin Locomotives Works, Philadelphia, Pa., has received an order from the Tennessee Valley Authority to build the fourth and last 42,000-hp hydraulic turbine for the Chickamauga Dam on the Tennessee River above Chattanooga. Delivery is scheduled for August 1951. This will make Chickamauga a completely equipped Baldwin station. The turbine is the adjustable-blade propeller-type, and will deliver 42,000 hp at 75 rpm under a normal head of 48 ft. Unit is also designed to develop at least 20,000 hp under a 25-ft head and 36,000 hp under a 36-ft head. To protect blade surfaces from damage by pitting, the contract calls for building up certain critical areas with stainless steel by welding. The runner diameter of the new turbine will be 22 ft and total weight assembled will be about 800 tons. Operating at a full load it will discharge up to 8750 cu ft of water per sec.

Crane Packing Co does not any longer represent Franklin Mfg Co, 149 S 4th St, Philadelphia 6, Pa., as distributor of Dudley electronic controls and Franklin precision ball-bearing tube expanders. Information will be supplied direct by Franklin Mfg Co.



"THE REMARKABLE CITIES SERVICE INDUSTRIAL HEAT PROVER TOLD US"



THE INDUSTRIAL HEAT PROVER is an exhaust gas analyzer, designed for use on industrial furnaces regardless of size or type. It is provided with two scales; one shows the percent of oxygen present above the theoretical amount necessary for complete combustion, the other the amount of unburned fuel going into the atmosphere.

"GUESS WORK on coal consumption was a critical problem with us. We had to know, ton-for-ton, exactly how much power we could generate efficiently. When the Cities Service representative demonstrated the Heat Prover, the results were astonishing. This remarkable instrument told us quickly, accurately and continuously how much fuel we needed for maximum efficiency... how much was wasted by needlessly heating excess air... and how we could correct this loss."

If you feel your operation could profit from scientific control of combustion why not get in touch with a Cities Service representative today. Ask for a free demonstration of the Cities Service Industrial Heat Prover.

Free— A new fact-filled booklet entitled "Combustion Control for Industry." Write Cities Service Oil Company, Room 495, Sixty Wall Tower, New York 5, N. Y.

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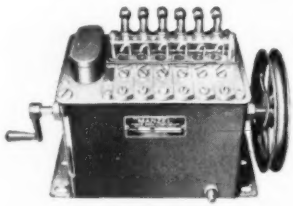
GOODBYE OIL HOG!

● Engines, pumps, compressors, and other machinery with inadequate lubrication systems quickly eat into profits. Install Manzel Force Feed Lubricators and say goodbye to heavy oil consumption, high labor costs, and frequent breakdowns due to poor lubrication. "Manzels" automatically supply precisely measured amounts of oil to each wearing point, assuring trouble-free service for many years. The FIRST year, they repay the modest initial expense many times over in lower operating cost.

Specify Manzel Lubricators on your next installation. Many leading manufacturers supply them as standard equipment. Or install them on your present machines.

Manzel engineers will gladly give you technical assistance on your lubrication problems. Write us anytime.



Manzel, Inc. now supplies repair parts for all models of Bowser and Torrington Lubricators.

Builders of HIGH PRESSURE METERING PUMPS Since 1898

Manzel INC.

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Industry Committee To Work With AEC

Recognition of the electric-power industry's vital interest in atomic energy development finally came in August with establishment of an industry committee to work with the Atomic Energy Commission.

The committee, headed by Philip Sporn, is temporary—it probably will wind up its duties early next year. But its chief objective is to pave the way for organization of a permanent industry advisory committee to bring technical know how into the AEC power reactor program, on the one hand, and, on the other, to keep industry informed on nuclear power development.

Chairman Sporn, who is president of American Gas & Electric Co and American Gas & Electric Service Corp, will share this responsibility with two other industry representatives on the temporary committee. They are Edward W Morehouse, vice-president of General Public Utilities Corp, and Walton Seymour, chief of the Interior Department's div of power.

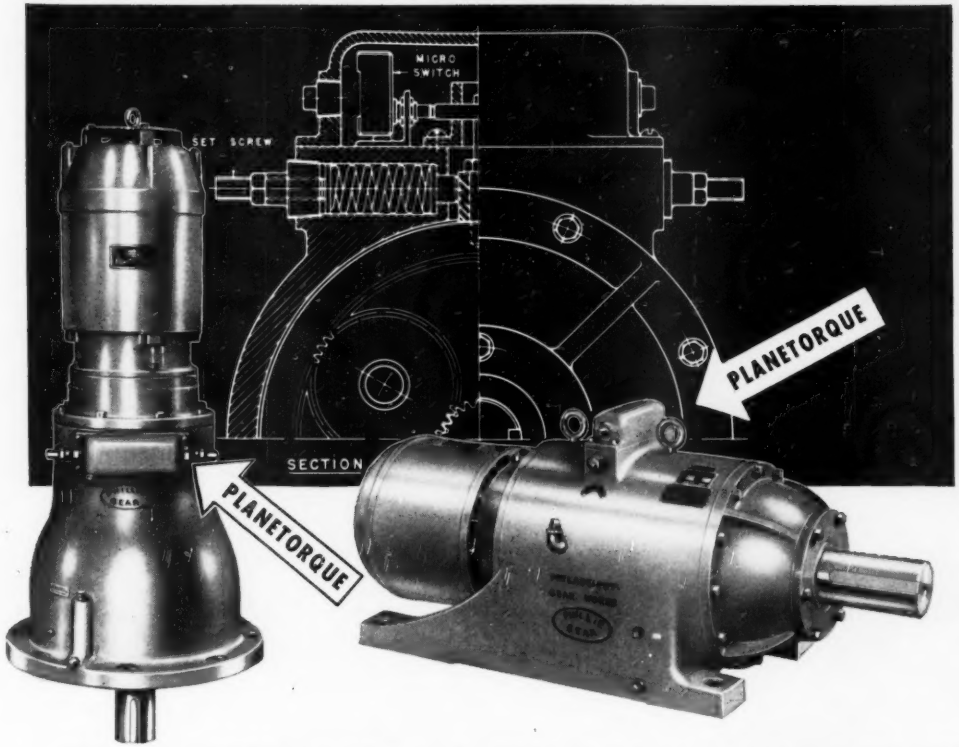
Westinghouse Electric Corp has entered into a $400,000 contract to build an 83,333-kva single-phase transformer to be mounted permanently on a railroad drop-center car for Bonneville Power Administration. This will be the largest portable transformer ever built. Unit will be used as a spare to replace temporarily any transformer of the same rating now in any of five substations of Bonneville Power Administration in Portland, Ore. district during maintenance operations or during an emergency.

The portable transformer will step down incoming transmission voltage of 220 kv to 110 kv when it is used as an autotransformer, or an insolated secondary winding will provide the full kva rating at 57 kv. A tertiary winding will provide power at 13.2 kv. Forced-oil-to-air cooling will be used and inertaire equipment will protect the transformer oil. High-voltage tap-changing-under-load equipment will make possible good voltage control during operation.

Because of transportation requirements on the Bonneville system, the transformer will be built horizontally rather than vertically to keep head room to a minimum. By keeping the long dimension of the transformer parallel to the axis of the car, bushings can be kept in place when transformer is moved from one substation site to another.

Bacharach Industrial Instrument Co, Pittsburgh, Pa., announces acquisition of manufacturing assets and patent rights for Adeco nozzle tester formerly manufactured by Aircraft and Diesel Equipment Corp. Company reports that the tester is already in quantity production and available for immediate delivery. Bacharach is also offering complete repair service for all Adeco testers now in use. Manufacturer states that a complete line of nozzle connectors and fixtures has been developed to permit testing any make and type of diesel nozzle and injector unit. A steel-carrying case has also been added to facilitate portable use of the tester. This case is suitable for all Adeco nozzle testers now in service.

PHILADELPHIA PLANETORQUE MOTOREDUCER



..GIVES INSTANT OVERLOAD PROTECTION

The **PlaneTorque** is a feature that may be supplied with any Philadelphia MotoReduceR *(combined motor and speed reducer)* to *protect* both the driven machinery and the drive unit from overloads.

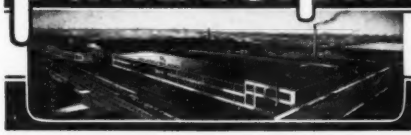
By direct mechanical action of the overload, motor current is *automatically and instantly cut off* when a pre-determined limit is reached. This action is quicker than electrical thermal relays provide. (With fuse protection, the fuses must be selected to carry the starting current of the motor; therefore, protection during running period is not adequate.)

The **PlaneTorque** can be cut-out during the starting period merely by holding down the starting button, but will become operative during the running period when the button is released. To restart the **PlaneTorque MotoReduceR** after overload cut-off, *only removal of the excessive load is necessary* . . . a big time saving feature.

For applications such as stoker drives, conveyor drives, mixers, agitators, roll drives, etc. . . . investigate the **PlaneTorque MotoReduceR.**

Send for new Catalog MR-49, and please use your Business Letterhead when writing.

Philadelphia Gear Works, INC.



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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

QUALITY in world famous W-S Forged Steel Fittings starts with proper selection of basic metals. Long before problems of forging, machining and testing arise, W-S technicians concern themselves with end uses in the determination of proper steel analysis for the various jobs Fittings must perform.

For example, working closely with Refinery engineers, W-S technicians helped establish standards for the physical properties of various fittings alloys . . . were first to use fitting materials of closely controlled uniformity (low sulphur-low phosphor) for the special demands of refinery services.

And, W-S has kept pace with changing methods in other processing industries too, meeting each new challenge with stronger, tougher alloys, producing forged fittings always correct — metallurgically.

They meet the broad, diversified needs of all industry and are available in both screw and socket weld types. Forged and precision machined of stainless, carbon and alloy steel . . . . Investigate.

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ROSELLE, NEW JERSEY

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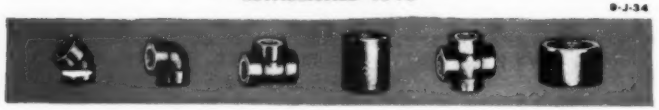


SOLD THROUGH LEADING DISTRIBUTORS

Jas P Marsh Corp, Skokie, Ill., announces purchase of Electrimatic Valve Div of Simoniz Co of Chicago. All Electrimatic valves will be manufactured by the Marsh Corp. The Electrimatic line includes pressure-actuatd condensing-water regulators for control of cooling water through condensers, solenoid stop valves for larger cooling systems, suction throttling valves, and backpressure regulators for evaporators. Line will be handled through Electrimatic Div of Jas P Marsh Corp, Skokie, Ill. Sale of Electrimatic products will be entirely by Marsh representatives.

A supplement to the *Handbook (H28)* (1944), *Screw-Thread Standards for Federal Services,* has been issued by the National Bureau of Standards. This publication makes effective a number of changes in American screw-thread standards that have been adopted by the Interdepartmental Screw-Thread Committee of the federal government since publication of 1944 edition. These revisions and additions, which had been approved by Sectional Committees B1, B2 and B18 of the American Standards Assn, are included. Supplement to *Handbook H28* (1944), *Screw-Thread Standards for Federal Services,* 57 pp, 28 tables, 14 figures, is available from *Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 25¢ a copy.*

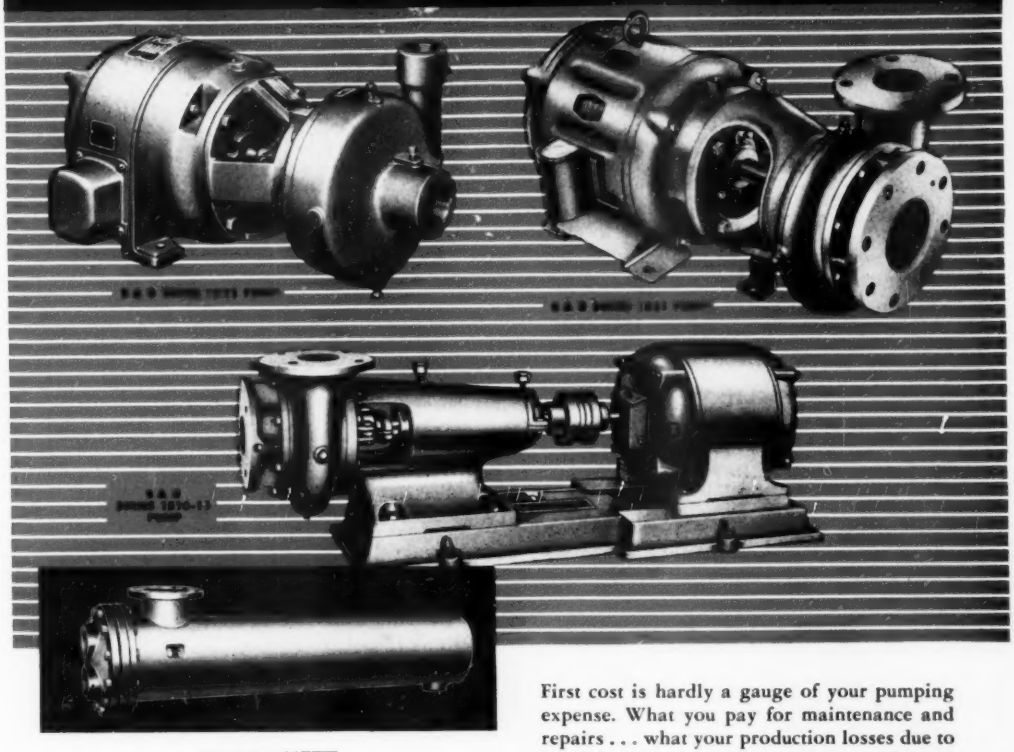
Dow Corning Corp announces a price reduction on *DC33, DC41* and *DC44* greases, which became effective Aug 1.

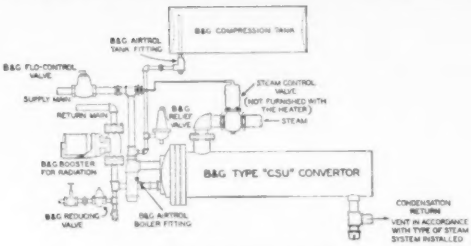
National Bureau of Standards announces that a revision of Simplified Practice Recommendation *R198-43,* Wire Rope, has been proposed by a standing committee, for reference by the Bureau to all interests for comment or acceptance, or both. The proposed revision, which adds a new table and effects a further reduction in variety of stock items, includes sizes, constructions, grades and breaking strengths of the vast majority of tonnage of wire rope. For the reason that as many wire-rope users as possible should have an opportunity to examine the proposed revision, the readers of this announcement are invited to make known their interest, by writing to *Commodity Standards Div, National Bureau of Standards, Washington 25, D.C.* Names of all firms that are not already on the Bureau's mailing list will be added immediately.

Nationwide scientific activity in field of air pollution has grown to such magnitude that a National Symposium on Air Pollution, presented by Stanford Research Institute in cooperation with California Institute of Technology, University of California and University of Southern California, will be held on Nov 10-11 at the Huntington Hotel in Pasadena.

Present plans indicate the 2-day symposium will cover some or all of the following subjects: (1) biological effects on plants and animals; medical effects (2) effect on visibility (3) meteorological aspects (4) methods of sampling and analysis (5) reduction or elimination of air pollution at its source (6) influence on industrial planning and plant location.

PUMPING OPERATIONS *Can* COST LESS





B & G HEAT EXCHANGERS

A complete line of units for steam-to-water and water-to-water heat transfer. Illustrated is the "CSU" Steam Convertor, as used to heat water for a forced hot water heating system. Write for Catalog BN-1048.

First cost is hardly a gauge of your pumping expense. What you pay for maintenance and repairs . . . what your production losses due to breakdowns amount to . . . these are the real measure of pumping costs.

When you select B & G Centrifugal Pumps, your good judgment will be rewarded by long, trouble-free and low cost operation. Design, material and workmanship all combine to produce pumping units which are winning the approval of engineers and operating men everywhere.

Before you buy your next pump, write for engineering data on B & G Series 1522, 1531, 1510-15 Centrifugal Pumps.

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Hydro-Flo PRODUCTS

B & G Hydro-Flo Products include Forced Hot Water Heating Equipment . . . Water Heaters . . . Centrifugal Pumps . . . Refrigeration Condensers and Evaporators.

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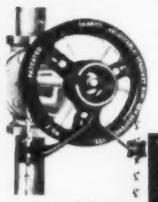
Overhead Valves EASILY, QUICKLY AND SAFELY controlled from the FLOOR!



Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

Range of 10 adjustable sizes takes care of all valve makes and types: fits valve wheel diameters from 2 to 30 inches.

• No more climbing up treacherous step-ladders, on benches, machines or boilers. High-up, inaccessible valves are brought down to earth by the inexpensive BABBITT Adjustable Sprocket Rim with Chain Guide. Here's overhead valve control that is just as positive as direct manual control, and 100% safer—right from the floor!

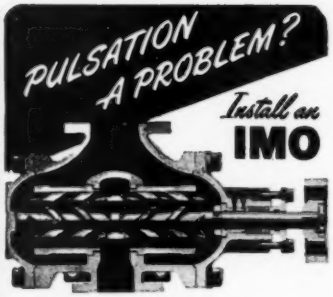
• The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

• *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.*

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

PULSATION A PROBLEM?

Install an **IMO**



With an IMO Pump delivery is not interrupted by the periodic strokes of a piston or the opening and closing of valves and ports. The turning of the rotors in an IMO forces the fluid from suction to discharge in a continuous, uniform flow.

IMO pumps can be furnished for practically any capacity and pressure required for oil, hydraulic-control fluids, other liquids.

Send for Bulletin 1-145P

IMO PUMP DIVISION of the
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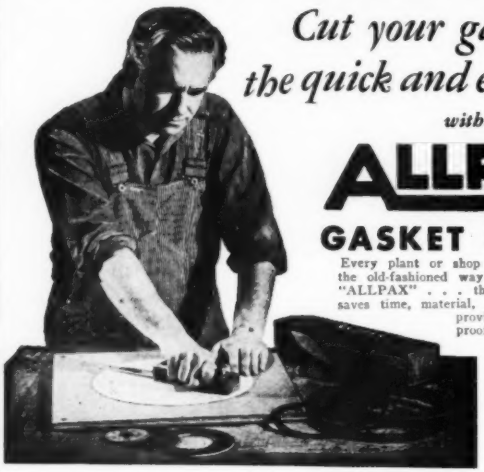
Cut your gaskets the quick and easy way with the

ALLPAX GASKET CUTTER



Every plant or shop now cutting gaskets the old-fashioned way by hand, needs an "ALLPAX" . . . the gasket cutter that saves time, material, labor and money. It provides a simple, foolproof method of cutting which can be done by anyone. Saves its cost in the first few gaskets cut. Cuts clean, accurate gaskets in any packing material from 1" to 36" diameter.

Furnished complete with six (6) double-edge cutting blades and one (1) 18" cutting board . . . all packed in durable hardwood case with hinged cover . . . ready for any gasket cutting job. Price $19.50 complete equipment, f.o.b. Mamaroneck, N. Y. ORDER NOW.

THE ALLPAX CO. INC.
Mamaroneck, N. Y.

Gould Storage Battery Corp, Trenton, N. J., invites companies utilizing motive-power storage batteries (industrial trucks) to send battery maintenance supervisors, materials-handling engineers, mine foremen and others, who are daily engaged in care, maintenance, and operation of storage batteries and battery-operated equipment, to a 5-day school on care, maintenance and charging of the storage battery. This second in the current school series, or 23rd in Gould's program of manufacturer instruction to battery users, will be held Nov 14 to 18 at Gould's Trenton plant. Purpose of the course is to help industry get the maximum efficiency and life from its storage batteries.

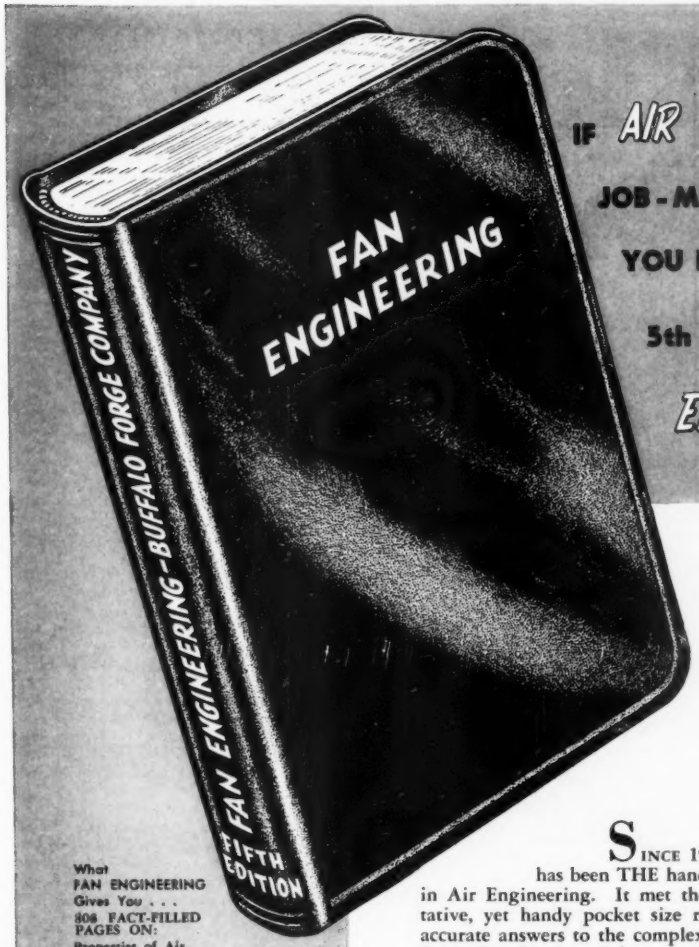
Federal Communications Commission has had under consideration since April 1948 rules respecting radio interference that would affect development and use of electric arc-welding devices utilizing radio frequency energy as part of the welding process. At a meeting of the commission, held on July 6, 1949, the FCC postponed the effective date of a proposed order applying such rules until Jan 31, 1950. While this action allows continued manufacture and sale of high-frequency, stabilized, arc-welding equipment for the next six months, the postponement was granted by the commission to provide more time for further investigation of high-frequency, stabilized arc welders and for further study of high-frequency radiation from this apparatus.

Donald N Watkins, president of Laclede-Christy Co, St. Louis, Mo., announces addition of following new products: silica brick, acidproof brick and Ohio firebrick. These Ohio-made products, added to Laclede's Pa., Mo., and Ala. firebrick, as well as glass-house refractories and high-temperature specialties, enable Laclede-Christy to supply users with one of the most complete lines of refractories manufactured in the U. S. The marketing of these new products was made possible when the Laclede-Christy Co board of directors approved a long-term sales contract with Davis Fire Brick Co and its affiliated companies at Oak Hill, Ohio.

Weighing 15,900 lb, the largest lubricated plug valve ever constructed has been completed and undergone the most rigid tests in the Nordstrom valve plant of Rockwell Mfg Co at Oakland, Calif. Twelve of these giant valves are being manufactured for the initial section of Pacific Gas & Electric Company's 34-in. gas pipeline from the Colorado River into the San Francisco bay area.

TVA has awarded contracts totaling about $18,000,000 for equipment for the $54,000,000 New Johnsonville steam plant. Largest contract went to General Electric for three turbine-generators, 125,000-kw each, at cost of $7,448,700. The three boilers are to be furnished by Combustion Engrg Co at $4,338,700.

Other contracts included Ingersoll-Rand Corp, $800,000 for three condensers; Lummus Co, New York, $200,000 for twelve feedwater heaters; American Blower Co, Detroit, $350,000, six fans, three induced-draft and three of forced-draft design.



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SINCE 1914, FAN ENGINEERING has been THE handbook for the man engaged in Air Engineering. It met the big need for an authoritative, yet handy pocket size reference book with quick, accurate answers to the complex problems of air handling. Revised and enlarged four times, FAN ENGINEERING is completely up-to-date — and more popular with engineers than ever before.

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VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

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BIGGEST STEAM TRAP NEWS

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INCREASES TRAP DRAINAGE CAPACITY OVER 100%!

Duo-Step Leverage — can save thousands of dollars annually for steam trap users . . . in lower initial cost and greater drainage efficiency.

DUO-STEP LEVERAGE NOW AVAILABLE IN THESE CLARK STEAM TRAPS
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Strainers
Pressure Regulators
Reducing Valves

THE CLARK MANUFACTURING COMPANY

Float Traps
Open and Inverted Bucket Steam Traps

APPOINTMENTS

Brown Instruments div, Minneapolis-Honeywell Regulator Co, names John A Robinson regional sales manager for its Midwest, Northwest Rocky Mountain and Pacific Coast territories. Robinson will maintain headquarters in Chicago, where he is succeeded by Charles E Sharp as Chicago branch industrial manager. George E Gilliam heads Brown pyrometer supplies, selling at the home office in Philadelphia.

William M Hankins joins **Owens-Illinois Glass Co,** Toledo, Ohio, as general sales manager of the company's Kaylo division.

Pennsylvania Flexible Metallic Tubing Co, Philadelphia, has elected William Townsend vice-president in charge of sales.

Samuel B Applebaum becomes manager of cold-process water-treating div of **Cochrane Corp,** Philadelphia.

Hall Laboratories Inc, Pittsburgh, Pa., appoints Joseph M Maloney to its research dept. He will specialize on problems of condensate-line corrosion and its control.

C C Bray has been made regional supervisor of new Midwestern district office opened by Imo-De Laval Products Div of **De Laval Steam Turbine Co.** Also, F H Bagley has been transferred to this office, at 1500 S Western Ave, Chicago 8, Ill.

Peabody Engrg Corp announces appointment of Eric G Peterson as general manager. He will continue as general sales manager of all products in all divisions, and will make his headquarters in New York City.

Frank O Walsh Jr is assigned to Southeastern territory of heavy machinery div, **Nordberg Mfg Co.** His offices are in the Volunteer Bldg, Atlanta, Ga. Walsh succeeds B C Fennell, who retired.

Allis-Chalmers names A Lawrence Stewart and Arthur L Foltz Jr sales representatives in Cleveland and Detroit district offices, respectively. Also, J F Fitzsimmons succeeds J R Reed as manager of the company's commercial research dept. Reed resigned to establish his own business.

Hayden Jones Jr and Norman Phillips have been added to the chemical laboratory staff of research and development dept of **Babcock & Wilcox Co** in Alliance, Ohio.

Westinghouse Electric Corp announces following personnel changes: John A DeGroot is transferred to San Francisco office as assistant to Charles A Dostal. DeGroot succeeds W J Howell, who is now assistant to Tomlinson Fort, manager of apparatus sales in Pittsburgh. Frank W Godsey Jr will manage newly formed special products development div, which absorbed the new products dept. G L MacLane Jr replaces Thomas L Spooner, retired, as manager of engineering laboratories. R S Kersh becomes manager of central station sales and F D Weatherholt is appointed manager of industrial sales. The latter two will be at East Pittsburgh plant. Also, a field office

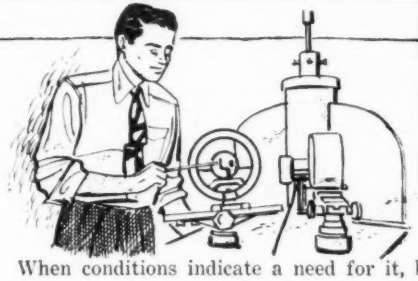
a Continuing Review of Conditions

WITH HALL BOILER WATER CONDITIONING

When the Hall System of boiler water conditioning gets under way in a plant, the boiler operator can usually maintain desired conditions without difficulty. Nevertheless, he is not left entirely "on his own," for Hall continuously reviews conditions and treatment.

From time to time water samples are sent to Hall Laboratories, together with the operator's report of his test results on that water.

These samples are carefully analyzed and the analysis compared with that of the boiler operator, so that he has a check on his work.



When conditions indicate a need for it, boiler deposits are also analyzed, using chemical, X-ray, spectrographic and other methods as required.

As a result of this continuing review, the boiler operator can be confident that he is handling the water treatment properly, and that he will not be caught unaware by any change in conditions.

The continued attention which Hall Laboratories gives to every client is another reason why so many plants of all sizes, in all parts of the country, continue to use Hall Service, year after year. Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

HALL LABORATORIES, INC.

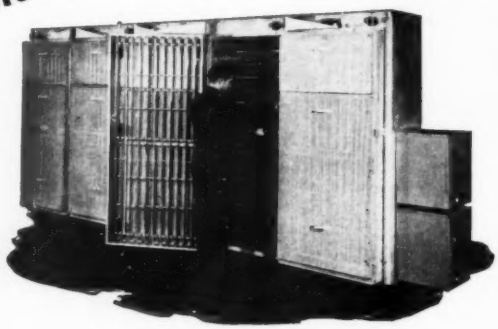
(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT

HALL SYSTEM OF BOILER WATER CONDITIONING

INDUSTRIAL WASTE RECOVERY AND DISPOSAL

Where clean air returns a cool profit



COOLING mill motors—either by force ventilation or a recirculating system—introduces a serious air cleaning problem. All of the air used with forced ventilation or that portion required for make-up with recirculation must be cleaned. The nature and volume of dust created by steel mill operation makes it necessary to clean any outside air entering the motor room.

This emphasis on clean air has increased the interest in electronic precipitation for steel mill service. The Electro-Cell washable type electric precipitator has proved extremely satisfactory for steel mill applications. Dust, soot and smoke are removed from the air with the highest efficiency. Design featuring removal collector plates offers a choice of maintenance methods—removing cells for servicing in special cleaning tank, manual washing and re-oiling in place or automatic cleaning in place without interruption of operation. Other features such as sectional construction and full-height hinged ionizers make for simplified installation and greater safety.

Whatever your motor cooling requirements, there's an AAF Filter of a type and capacity to meet your needs. Write for complete catalog data on the Electro-Cell and other AAF electronic filters.

AMERICAN AIR FILTER COMPANY, INC.
201 Central Ave., Louisville 8, Ky.
In Canada: Darling Bros. Ltd., Montreal, P. Q.

AAF

AIR FILTERS
AND DUST CONTROL EQUIPMENT

is now established in the Brown-Marx Bldg, Birmingham, Ala., for the Sturtevant Div of the firm, with V E Barnes in charge.

Frank M Mason Jr has been made director of engineering of **Fairbanks, Morse & Co.** He will remain at the firm's headquarters in Chicago, Ill.

Taylor Instrument Companies, Rochester, N. Y., appoints William H Corwin public relations director.

Martin R King has succeeded C P Fischer Jr as manager of **General Electric** Apparatus Dept news bureau. Fischer has been named manager of a new promotional div.

Youngstown Sheet & Tube Co is establishing a dept of public relations in charge of Stuart D Goulding, director. His office will be in the Stambaugh Bldg, Youngstown, Ohio. John E Stukel Jr joins the operating dept as a development engineer. Also, David H Goodfellow is promoted to assistant district sales manager of Detroit sales office.

S G Mayfield has been chosen to represent **Cardox Corp** in the New Orleans area. His territory runs along the Gulf from Mobile, Ala. to Vermilion Parish, La., covering two counties in Alabama, six in Mississippi and about one quarter of Louisiana, including New Orleans, Baton Rouge and Lafayette. Mayfield's office address is 534 International Trade Mart, New Orleans 12, La.

Universal Atlas Cement Co, New York, announces following elections: Henry P Reid, vice-president—engineering; Charles B Baker, assistant to president; Fred T Wiggins, vice-president and assistant general sales manager; and George S Neel, Western sales manager, Chicago. Also, promotions as follows: Wendell R Doolittle Jr, sales manager, metropolitan Chicago territory; Thomas E Bertelsen, assistant sales manager, Chicago territory; and Joseph R Lair, district sales manager, Indiana-Michigan district.

Plastics and ammonia departments of **Du Pont Co** have been combined into a single industrial dept. The consolidated dept will be headed by Dr Emil D Ries, and its headquarters remain in Wilmington, Del.

Jeffrey Mfg Co, Columbus, Ohio, reports following personnel changes: F E McGovern is transferred to coal-preparation sales. Henry W Nau replaces McGovern in coal-preparation engineering div. J R Brisley takes over duties as district manager at Baltimore succeeding H C Rockwell, who returns to product sales div at the home office. Charles E Lawall Jr is assigned to Philadelphia office.

Euclid Electric & Mfg Co, Madison, Ohio, elects C J Rowles vice-president in charge of sales.

H L Schreiner joins **Sylvania Electric Products Inc** as field representative in the company's Los Angeles div office. F H Heintz becomes division sales manager of

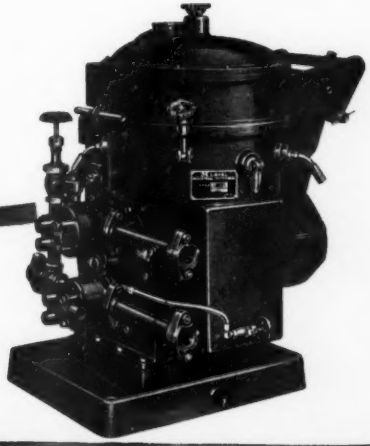
NO HALFWAY MEASURES

IN *my* TURBINE PROTECTION

"I am De Laval Centrifugal Force. When I protect a turbine my protection goes the whole distance. I remove **both** contaminants—**dirt** and **water**—and keep the lubricating oil at its best at all times."

It is never sufficient to remove just dirt from turbine oil. While dirt obviously soon ruins oil as a lubricant, as often as not the chief offender in that respect is **water**. For water, either as condensate or in the form of a sudden leak, leads directly to the formation of sludge. It is also apt to emulsify the oil and cause serious difficulty in that way.

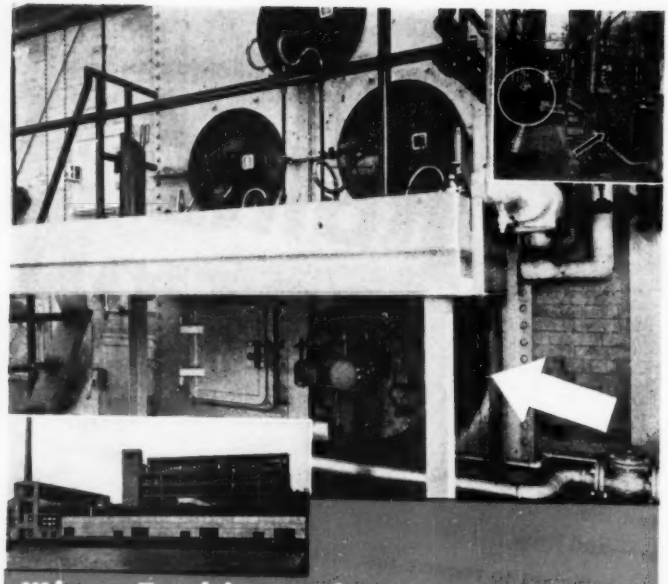
De Laval Oil Purifiers, wholly mechanical in action, remove dirt and continuously discharge the water, effecting separation by centrifugal force. The machines maintain full efficiency of purification right to the moment when the bowl is full of dirt and must be cleaned.



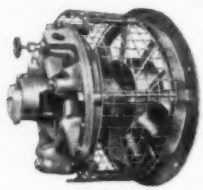
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

De Laval

OIL PURIFIERS for more dependable power production



Wing Turbine Blowers Combine Absolute Dependability With Complete Forced Draft Efficiency



Shown above is a typical Wing Turbine Blower installation serving one of the world's largest coffee packing plants. Note that the engineer (upper right photo) is able to talk on the telephone a few feet away from the Wing Turbine Blower—ample proof of its quiet operation. Write today for Bulletin

In addition to these prime requisites, Wing Turbine Blowers have many extra money saving features including minimum cost of operation, simple, rugged, and compact construction, and because little or no duct work is required, no time and expense is required for engineering layout. Where plants can make use of the low pressure steam from the Wing Turbine Blower for such uses as feed water heating, process work, or space heating, the forced draft is obtained at negligible cost.

L. J. Wing Mfg. Co. **50th and 7th Ave., New York 11, N. Y.**
Factories: Newark, N.J. and Montreal, Canada

Wing

AXIAL FLOW BLOWERS

Southwestern div with offices in Kansas City, Mo. Heintz succeeds J C Hicks, who is now sales manager of firm's Canadian subsidiary, Sylvania Electric (Canada) Ltd.

W P & R S Mars Co, 322-324 W Michigan St, Duluth, Minn., has been appointed a distributor for **Ampco Metal Inc** in northern Minnesota, upper peninsula of Michigan and northern counties of Wisconsin.

Perfex Corp, Milwaukee, has named W A Matheson Jr manager of its newly created new products div.

Rietze & Co, 139 S 5th St, Louisville, Ky., is selected by **Standard Transformer Co** as its representative in the state of Kentucky.

Ohio Brass Co, Mansfield, Ohio, has reported following changes in its organization: Merrill W Manz has been designated vice-president; Roger A Black, general factory manager; and H E Shoemaker, manager, foreign trade dept.

Glenn H Alberga joins **Laminated Shim Co** as plant manager at the Glenbrook, Conn., plant.

Air Reduction Sales Co discloses following personnel changes: J B Davenport becomes assistant manager of Charlotte district. J H Hart is promoted to assistant manager and is succeeded by R A Jamieson as assistant sales manager, in Detroit. Assistant manager of Boston district is A S Blodget Jr. Frank J Aschenbrenner and Earl C Clark are appointed assistant directors of research and engineering. Aschenbrenner will be in charge of Murray Hill, N. J. laboratory, and Clark in charge of development and engineering groups. Technical relations dept is now with secretary's dept. Also, Dr L I Gilbertson becomes administrative manager-in-charge of business management, and L B Dobbins, supervisor of plant engineering.

In addition, **Airco** names J K Hamilton manager of apparatus research div with H O Klinke as assistant manager. J T McKnight assumes duties as superintendent of production and services section, and T J Cholis becomes supervisor of patent section. These men are all in Murray Hill, N. J.

Davey Engrg Sales Co, St. Louis, Mo., has been appointed by **United Centrifugal Pumps** Div of United Iron Wks as its respresentative in that territory.

Wilkening Mfg Co assigns Ralph Doherty as division manager of the areas comprising generally the West North Central states. He will headquarter in Kansas City.

Carl D Smith joins **LeTourneau Co** as special representative of sales division. Currently, Smith will maintain headquarters in Peoria, Ill.

Chain Belt Co has chosen Bearing & Transmission Co, 400 Walnut St, Findlay, Ohio, as distributor for its chain and transmission and its Baldwin-Duckworth divisions. Barker-Jennings Hardware Corp.

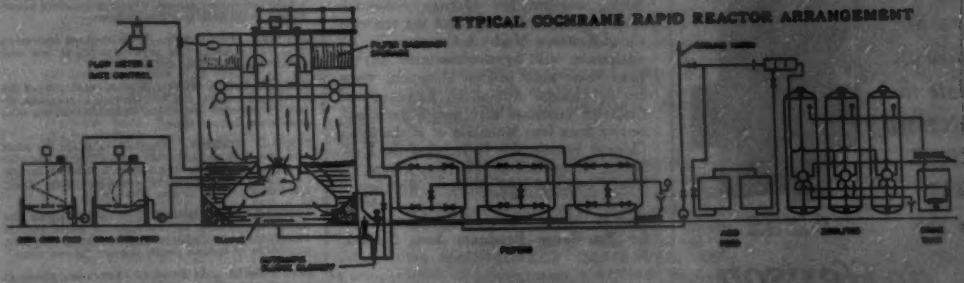
RAPID REACTORS

COMBINING the basic elements of equipment for mixing, floc formation, settling, and thickening in a single reaction vessel, the Cochrane Rapid Reactor is finding widespread application in industry for the conditioning of process cooling water and boiler feed. Chemical reagents may be introduced for coagulation of turbidity alone, for partial softening with coincident turbidity reduction, or for complete softening and turbidity reduction. The choice of reagents will be governed by the characteristics of the raw water and the purpose for which the treated water is to be used.

By its improved design, the Cochrane Rapid Reactor permits chemical reactions and separation of coagulated solids in only a fraction of the time necessary in intermittent cold process softeners. The retention time in a Cochrane Rapid Reactor will depend upon conditions, but usually is of the order of 60 to 70 minutes, as compared to four hours or more with conventional cold process softeners or clarification systems.

This improvement is attained by scientific application of an old principle of sludge recirculation in which the sedimentation tank is so arranged with forced pumping of the sludge that when the chemicals are added to the incoming water they react in the presence of large quantities of sludge; the sludge seeds the precipitation and accelerates the chemical reactions. In addition to the acceleration of the chemical reactions the initial precipitate, which is colloidal in nature, is rapidly coagulated and separated from the water. From this fact the device derives its name "Rapid Reactor."

TYPICAL COCHRANE RAPID REACTOR ARRANGEMENT



COCHRANE

COCHRANE CORPORATION • 3106 N. 17th Street • PHILADELPHIA 32, PENNA.

EISLER TRANSFORMERS

STANDARD & SPECIAL

From 1/4 to 400 KVA
up to 15,000 volts
We manufacture a complete line of:
*AIR, OIL OR WATER-COOLED DISTRIBUTION TRANSFORMERS

*Special Designs available to meet Customers' Specific Requirements.

TRANSFORMERS FOR
* ELECTRIC FURNACES
* WELDING
* HEATING
* PHASE CHANGING
Etc.

POWER & LIGHT TRANSFORMERS

For isolation of Light from Power, or Light from Telephone

EISLER TRANSFORMERS are manufactured strictly to Standards of the N.E.M.A., A.S.A., and A.I.E.E.

WRITE FOR SPECIAL CATALOG

EISLER ENGINEERING CO., INC.
Chas. Eisler, Pres.
757 South 13th Street, Newark 3, N. J.

All UNIONS are NOT alike... Note the RECESSED BRASS SEAT in the

All-Female 45° Union Elbow

Jefferson

All Jefferson Unions are made of air-refined malleable iron having a tensile strength of 55,000 lbs. per sq. in. This assurance of dependable strength is supplemented by the exclusive Recessed Brass Seat which is a patented feature found in no other pipe union. This construction has proved definitely superior in countless thousands of installations. Pipe ends cannot come in contact with the seat; there is nothing in the runway to restrict free flow.

Get full details by contacting your nearest distributor or us direct.

JEFFERSON UNION CO.
605 W. 26th St., New York 1, N. Y.
61 Gooding St., Lockport, N. Y.
12 Fletcher Ave., Swampscott, Mass.

1000-1002 Commerce St, Lynchburg, Va., and Buford Brothers Inc, 125 10th Ave S, Nashville, Tenn., have also been chosen distributors for above divisions and for conveyor and process equipment div. In addition, John C Toomey has become district sales engineer in Detroit district office and Douglas Jones, manager of Salt Lake City district office. Jones will operate his usiness as Douglas Jones Co, 1551 Redondo Ave, Salt Lake City, Utah.

Hallett Mfg Co, Inglewood, Calif., announces election of William D Brumbach as vice-president in charge of sales; W W Schrein, secretary-treasurer; and V C Capfer, manager of service.

E R Traxler has been named manager of a new flat-belting field engineering and development dept in **B F Goodrich Co's** industrial products div.

Raytheon Mfg Co selects Art Cerf & Co, 744 Broad St, Newark 2, N. J., as sales representative for their voltage stabilizers in upper New York State area.

Walter M Reynolds has been elected secretary of **Morse Chain Co,** div of Borg-Warner Corp. He also retains his post as controller of the division. Duties of treasurer have been assumed by R P Johnson, first vice-president.

Photoswitch Inc appoints Oscar C Stark general sales manager with headquarters at 39 Broadway, New York City.

Dr Amos Turk is designated director of research and development of **W B Connor Engrg Corp,** New York, N. Y.

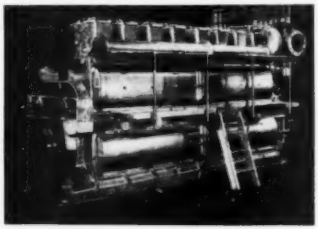
Lake Shore Engrg Co, Iron Mountain, Mich., acquires the Chicago Automatic Conveyor Co of Chicago, and the conveyor div of Kewanee Machy & Conveyor Co. All equipment will be manufactured at the Lake Shore plant in Iron Mountain. Owners of Chicago Automatic, Kewanee and Coaltoter machines may secure parts and service from Iron Mountain or at the firm's Chicago branch, 350 N Harding St. B W Reeve, vice-president of Lake Shore, is named head of new conveyor div.

Karl H Mayers is new advertising manager for **Purolator Products Inc,** Newark, N. J.

W S Ehrenfeld Co, 531 W King St, York, Pa., has been selected as distributor by **Carboloy Co Inc** for York and surrounding region. Tool Supply & Engrg Co, 1901-1903 Canton St, Dallas, has been chosen for Dallas and northern Texas territory.

U. S. Rubber Co names Howard H Weber general sales manager of its wire and cable dept. In addition, the following are chosen divisional sales managers: Clarence H Le Vee, with headquarters in New York City, will supervise sales in Boston, New York, Buffalo, Syracuse, Philadelphia, Baltimore, Atlanta and Pittsburgh branches. J A Leuver, Chicago, will handle Cleveland, Detroit, Chicago, Cincinnati, Indianapolis, Milwaukee, Minneapolis and Omaha. Don B Karlskind, Dallas, Texas, will be in

The ALCO PLAN for DIESEL ECONOMY



Flexibility and Low Cost Offered by ALCO Standardized Engine

THE ALCO plan helps Diesel plants where flexibility, economy, dependability, and provision for future growth are important. In one size of stationary Diesel engine, ALCO offers unusual advantages where multiples of 540 to 1,300 horsepower can be used.

LOW COST...This basic design, also used in ALCO switch engines, is quantity-produced to make both first cost and the cost of replacement parts unusually low.

FLEXIBILITY...You can fit fluctuating load curves more closely than with fewer engines of larger size, or of varied capacity.

LESS WEAR...This more efficient use of engines means less wear per installed horsepower. The unused capacity of operating engines at any time need not exceed the capacity of one engine. There is no wear on the idle engines. Larger engines would necessitate greater wear per installed horsepower, with resulting higher costs.

GREATER EFFICIENCY...With engines operating near rated load, fuel consumption is less and operating conditions are better.

UNIFORM ENGINE WEAR...With several units of the same size, engines can be operated in rotation, allowing planned inspection and maintenance with minimum "down time."

STAND-BY ECONOMY...When all units are the same size, stand-by capacity can be limited to one size of engine the same as all others. With a variety of engine sizes, stand-by capacity might easily have to equal the largest single unit.

SIMPLIFIED MAINTENANCE...Uniform engine size means uniformity of replacement parts and of maintenance procedures; smaller stocks of parts; minimum of special tools; shorter "down time."

EASY GROWTH...As demand increases, gradual growth can take place by adding extra units of the same size.

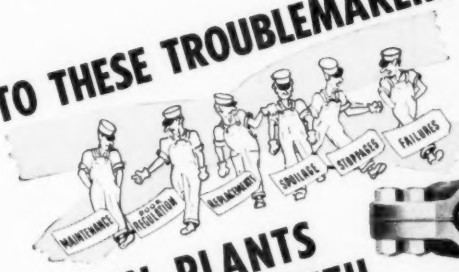
• • •

What your actual savings can be with this compact, efficient engine should be computed carefully. Call in an ALCO engineer to discuss the ALCO plan in relation to your needs.

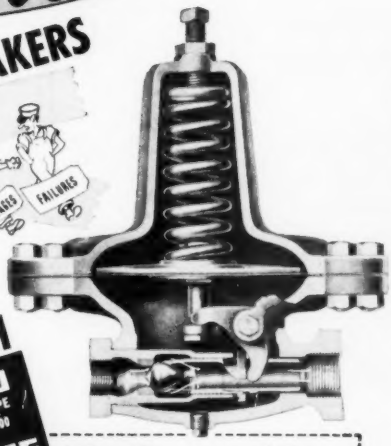
AMERICAN LOCOMOTIVE COMPANY
Department D-6, 30 Church Street, New York 7, N. Y.

ALCO
STANDARDIZED
DIESEL ENGINES

IT'S GOODBYE Forever TO THESE TROUBLEMAKERS



IN PLANTS EQUIPPED WITH CASH STANDARD Streamlined PRESSURE REDUCING VALVES TYPE 1000



The Reasons Why IT HAPPENS ARE TOLD BY USERS AS FOLLOWS . . .

Check what the users say against the Benefit Points Below

• A Rubber Goods Manufacturer says—

"We have used these Type '1000' valves for several years with fine results on air or water service at pressures from 10 lb. to 300 lb. depending on requirements. These valves as claimed have been found to have **LARGE CAPACITIES.** On **FLUCTUATING LOADS** or **STEADY LOADS** they are **MOST DEPENDABLE, RAPID IN ACTION** with a **QUICK DEMAND** and **TIGHT CLOSING** when the load drops off. They require but a **MINIMUM OF SERVICE OR MAINTENANCE.**"

• A Chemical manufacturer says—

"The CASH STANDARD Type '1000' valves which we have in service have fulfilled the conditions checked . . . **(ACCURATE PRESSURE CONTROL UNDER TOUGHEST WORKING CONDITIONS), (TROUBLE FREE SERVICE), (TIGHT CLOSURE)** better than any other steam pressure reducing valves that we have used."

• A Metal Products company says—

"We have had a number of your CASH STANDARD Type '1000' valves in operation in our plant for a number of years. These valves have proved to be satisfactory in every respect. We particularly like this type of valve because it is **SIMPLE TO INSTALL, REQUIRES A MINIMUM OF MAINTENANCE,** and gives **CONTINUOUS** and **UNIFORM PRESSURE CONTROL.**

• A Plant Engineer says—

"We find that the CASH STANDARD Type '1000' streamlined valves are best suited for our various applications of compression molding because of their **VERY WIDE RANGE OF ACCURATE PRESSURE CONTROL.** The simplicity of construction of these valves has kept the **MAINTENANCE COSTS VERY LOW** which of course means a **SAVING IN COST OF OPERATION,** and **SPEEDIER PRODUCTION.**

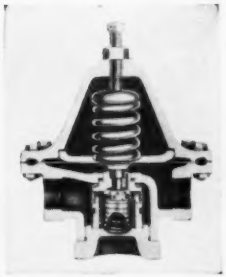
1. **Maximum capacity when needed most.**
2. **Accurate pressure control under toughest working conditions.**
3. **Trouble-free service.**
4. **Smooth operation.**
5. **Tight closure.**
6. **Speedier production results.**
7. **Elimination of failures.**
8. **Cost-saving operation.**
9. **No spoilage.**
10. **Practically zero in maintenance.**

WRITE FOR BULLETIN 962

CASH STANDARD CONTROLS . . . VALVES

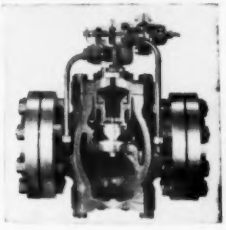
A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES
Send for them



Bulletin 950—features the CASH STANDARD Type D Single Seat Pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.

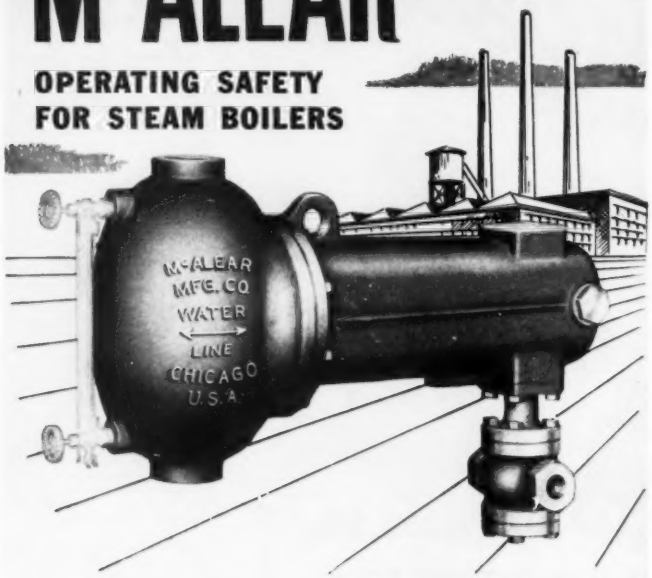
Bulletin 956—features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.



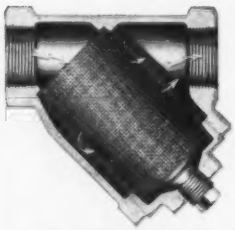
Bulletin 966—features the CASH STANDARD Self-Contained, Pilot Operated Type 10 Pressure Reducing and Regulating Valve for use with water or air; with any gas or oil that is non-corrosive; and with refrigerating fluids such as Ammonia and Freon. Many interesting particulars explained such as: how valve works, tight seating, large capacity, no waste, no water hammer or chatter.

McALEAR

OPERATING SAFETY FOR STEAM BOILERS

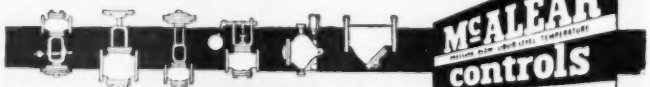


Eliminate the human element in the control of boiler water supply. Provide protection for life and property with the McAlear No. 906 Feed Water Regulator. Result: A constant, safe water level at all times. Adaptable to either single boilers, or those installed in batteries, the No. 906 also means greater efficiency and lower fuel costs through elimination of intermittent slugs of cold water. This simple-in-design regulator is built for use with heating boilers of 10,000 sq. ft. radiation and more, or for high pressure boilers of 50 HP or more operating up to 600 pounds pressure. Other types available with level or pressure switches. For details, request a copy of Bulletin No. 122.



For positive protection of valves, pumps, meters and other equipment in your piping system, install McAlear strainers. Bulletin No. 128 lists the standard line. *Any* type, *any* size, available.

McALEAR Mfg. Co.
1909 SOUTH WESTERN AVENUE
CHICAGO 8, ILLINOIS



REPRESENTATIVES IN PRINCIPAL CITIES

AN INDEPENDENT MANUFACTURER FOR OVER 40 YEARS

charge of Birmingham, New Orleans, Houston, Dallas, Kansas City, Tulsa, St. Louis and Denver. L M Guibara, Los Angeles, will be responsible for Los Angeles, San Francisco, Portland, Seattle and Salt Lake City. Also, Matthew J Delehaunty succeeds J W Greenwalt, retired, as district sales manager for Pittsburgh branch of mechanical goods div.

C J Tagliabue Corp announces appointment of following district sales representatives: E A Thornwell Inc, Atlanta; Ranson, Wallace & Co, Charlotte; Ambos-Jones Co, Cleveland; Butler & Land, Dallas; Lynn Elliott Co, Houston; Curtis H Stout, Little Rock; Geeseka & Pinkney, Minneapolis; Joralemon, Craig & Co, Philadelphia; J E Redmond Supply Co, Phoenix; Riddle & Hubbell, Tulsa.

Frederick Fahnoe joins staff of chemistry dept of **Kellex Corp.** subsidiary of M W Kellogg Co.

E F Houghton & Co has split its Eastern sales div into two sections: Eastern sales North, which will include New England and New York State, and Eastern sales South, including Pennsylvania, New Jersey and Delaware. Orum R Kerst will head the North section with headquarters in Worcester, Mass., and J R Clendenning will take over the South, with offices in Philadelphia. A C Smith has been promoted to sales co-ordinator for the two Eastern sections.

Harry T Graham is made assistant general sales manager of **General Refractories Co,** Philadelphia.

Eutectic Welding Alloys Corp, New York City, has added Dr Eugen Sovegjarto to its research staff.

A C Runnette succeeds Wiser Brown as manager of sand and permanent-mold casting products sales for **Aluminum Co of America,** Pittsburgh. Brown will devote his full time to the company's activities in magnesium products.

Reliance Electric & Engrg Co reports following personnel additions to its district offices: Emory G Orahood Jr goes to Atlanta, Ga.; Robert B Reed to Birmingham, Ala.; and John Drollinger Jr to Detroit.

J R Williams assumes duties of Chicago district manager for **Electric Products Co.** His territory covers industrial area in 19 counties of northern Illinois, all of Indiana, Iowa, Minnesota, Wisconsin and most of the upper peninsula of Michigan.

Santa Fe Tank & Tower Co, Los Angeles, appoints Dr N W Snyder, assistant professor of mechanical engineering at University of California, to its staff as chief technical consultant.

Ramtite Co, boiler setting contractors, announces establishment of a direct branch office at 1530 River Bed Ave, Cleveland 13, Ohio. Joseph J Moore is in charge.

Crotty Co Inc, 133-15 35th Ave, Flushing, N. Y. has been chosen as franchise dis-

How to completely eliminate BOILER scale and corrosion

BORGANA, NEW BOILER TREATMENT

Remarkable Discovery Solves Boiler Troubles

Portland, Ore., Oct. — Borgana, a new organic boiler treatment developed from the Red Cedar shingle industry, dissolves and prevents scale and silica. It prevents corrosion, foaming and oil trouble. Results are positive.

TESTED AND PROVED

Fifteen years of research and testing under the most adverse boiler conditions have proved Borgana's effectiveness. Borgana envelopes the particles of incrustive substances with a colloidal film preventing their adherence together and to the metal surfaces . . . in entire system.

SAFE IN ANY INDUSTRY

Borgana is odorless and harmless where live steam is used. It will in no way contaminate foodstuffs, dyes or any other industrial processes. Water from any natural source can be used. Borgana comes in liquid form and is safe to handle.

Treats Entire System

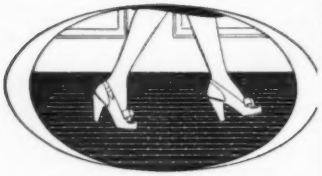
RESULTS GUARANTEED. Borgana is guaranteed to remove scale and to keep your boilers clean when used according to manufacturer's recommendations. Borgana is low cost . . . applied only once every seven days.

BORGANA
BOILER TREATMENT

Chemical Division
Portland Shingle Company
9036 N. Denver Ave.
Portland 3, Oregon

Write today for full information. A complete explanation of how Borgana will solve your boiler problems.

THE **SAFE**
OPEN STEEL FLOORING
IS **TRI-LOK**



No object over ½ square inch can pass through super-safe U-Type Tri-Lok Flooring. Fabricated without bolts, rivets or welds, it is unsurpassed for plant installation, walkways, loading platforms. Efficient distribution of concentrated loads . . . maximum free opening for light and air. Write for Bulletin JZ 1140.

DRAVO CORPORATION

National Distributor for the Tri-Lok Company

Dravo Bldg., Pittsburgh 22, Pa.

Sales Representatives in Principal Cities

DRAVO

High Pressure Steam at Low Cost

SCOTTIE JR®

KEWANEE®

6 sizes for 6 to 36 hp at 100 lbs wp . . . For coal, oil or gas . . . hand or mechanically fired.

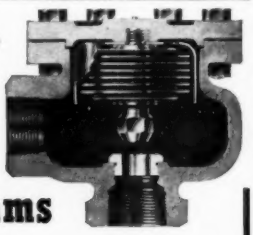
Check the proportions of each Scottie Jr. and you'll see why it will actually produce approximately double the horse power guaranteed by its rating.

WRITE Department 99-K10 for 6" scale with pipe diameter markings

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

Branches in 60 Cities—Eastern District Office: 60 West 49th Street, New York City 18
Division of American Radiator & Standard Sanitary Corporation

WHY →

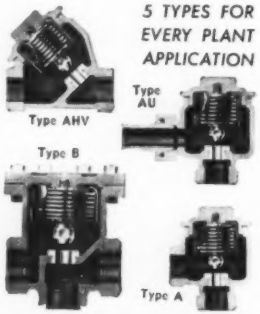


Nicholson Steam Traps Are Being Adopted in

Advanced PLANT ENGINEERING Programs

The repeated adoption of Nicholson steam traps in plants with big "cost-reduction-through-modernization" programs is a noteworthy indication of their advanced features. For instance, where manufacturing is put on a continuous basis Nicholson traps help maintain essential operating conditions because they: 1) operate on lowest temperature differential for faster action; 2) eliminate adjusting valves for varying pressures; 3) prevent air-binding; 4) furnish 2 to 6 times average drainage capacity. Size ¼" to 2"; press. to 225 lbs.

5 TYPES FOR EVERY PLANT APPLICATION



Catalog 448 or see Sweet's

W. H. NICHOLSON & CO.

125 Oregon St., Wilkes-Barre, Pa.

tributor for the **Todd** oil-burning line in tch boroughs of Manhattan and Bronx, New York City.

Henry O Pond, of **H K Ferguson Co,** New York City, engineers and builders, is re-entering private practice of consulting engineering. He will retain connection with the above firm in a consulting capacity.

Having been elected vice-president and director of **Pioneer Service & Engrg Co,** Chicago, George W Knoure has joined the staff of the organization.

R H Bacon is elected president of the **Chicago Technical Societies Council** for 1949-50. He is vice-president of Kreicker & Meloan Inc, industrial advertising agency.

Frank L Wadsworth, consulting engineer, announces opening of an office at 444 Exchange St, Geneva, N. Y., with a branch at Dresden, N. Y.

Carolina Power & Light Co promotes Raymond S Talton to newly created position of production engineer.

Harlee Branch Jr has been elected vice-president and general manager of **Georgia Power Co,** and also a director of the company.

Louisiana Power & Light Co names R L Phillips general superintendent of power in charge of Sterlington and Ninemile Point generating plants. John R Horton becomes superintendent at Ninemile and is succeeded by Carl D Brooks as station chief at Sterlington.

Mutual Boiler Insurance Co of Boston has opened a resident inspection office at Box 87, Amawalk, N. Y. under direction of W G Rance, resident inspector. Another office has been established at 10342 Santa Monica Blvd, Los Angeles, Calif., with A J Gray in charge.

H L Miner, manager, safety and fire-prevention div, E I duPont de Nemours & Co Inc, is elected chairman of Safety Code Correlating Committee of **American Standards Assn.**

W E Mahin has been named director of resarch at Armour Research Foundation of **Illinois Institute of Technology.** He replaces Dr. Martin H Heeren.

OBITUARIES

William F Ochlschlager, 65, retired president of Buckeye Boiler Co, died Aug 17 at his residence in Oakwood, Ohio.

William Lloyd, 82, stoker designer and consultant on stoker engineering for Combustion Engrg-Superheater Inc, died Aug 7 in New York following a brief illness.

Thomas G Estep, 66, who retired this year as professor of mechanical engineering at Carnegie Institute of Technology, died Aug 7 at his home in Alexandria, Pa.

John L Daly, 70, a member of the sales dept of Combustion Engrg-Superheater Inc, died Aug 16 in New Brunswick, N. J.

STRENGTH

for Safety and Long-Time Service

For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SCREW END TYPE

For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

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Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-8 will aid you in their selection and proper application.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

HENRY VOGT MACHINE CO., INC.
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BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

Vogt — DROP FORGED STEEL FITTINGS

INCREASING YOUR HOLD ON YOUR JOB

and giving yourself a chance for advancement

Few men deliberately plan to work persistently on self-improvement. If progress comes naturally, they are happy; if it does not, they either worry or they entirely ignore the situation.

Yet it is possible to pay attention to self-improvement with considerable hope of success. A noticeable degree of advancement is practically *assured* to anyone who will make an intelligent and persistent effort.

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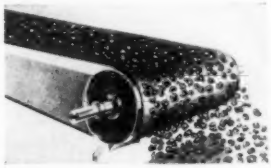
THERE is a Dings Magnetic Separator for every power plant or boiler room requirement . . . from the big 48" x 48" electromagnetic pulleys used by modern central stations to the little Alnico Perma-Plate magnets for plants using small stoker-fired heating boilers. Detailed descriptive literature and recommendations from Dings engineers are available on request to help you select the separator best suited to your needs.

MAGNETIC PULLEYS

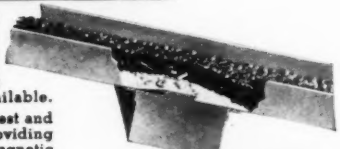


Magnetic Pulleys are recommended on the majority of belt conveyor installations because they *automatically* remove and discharge the tramp iron.

NEW! THE ALNICO PERMA-PULLEY—magnetic permanence *guaranteed* for the life of the installation . . . powerful, trouble-free. Suitable for most pulley requirements. Ask for Catalog C-1007A.

AIR-COOLED ELECTROMAGNETIC PULLEY—recommended for very heavy burdens because of great depth of magnetic flux penetration. Catalog C-1001A.

RECTANGULAR ELECTROMAGNETS

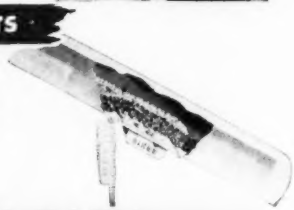


Uniform magnetic flux pattern across entire face of magnet, plus great depth of magnetic penetration and high surface strength, make Dings triple pole rectangular magnets the most powerful tramp iron magnets available.

CHUTE TYPE—stepped face helps arrest and hold iron mechanically as well as providing extra magnetic edges for intense magnetic concentration. Available with automatic safety gate to stop flow if current is interrupted; gate also used to remove accumulated iron. Catalog 301-A.

SUSPENDED TYPE—recommended for use above belt where pulley is not applicable due to excessive speed, burden depth or other reasons. Also used above chutes. Available in AUTOMATIC SELF-CLEANING TYPE with cross belt which discharges iron to the side. Ask for Catalog 301-A.

NEW! PERMA-PLATE MAGNETS



Here's low cost, powerful, permanent magnetic protection. For installation above or in chutes and above belts. Ideal for stoker protection. Non-electric; magnetic permanence *guaranteed* for life of installation. Send for Bulletin B-1205A.

Dings MAGNETIC SEPARATION HIGH INTENSITY

DINGS MAGNETIC SEPARATOR CO.
4765 W. Electric Avenue
Milwaukee 14, Wis.

"Separation Headquarters Since 1899"

Why pull is no problem to teeth in this new Motorgear

YOU can mount a sprocket, gear or pulley on the low speed gear shaft of this new Fairbanks-Morse Motorgear with no worries about outboard pull.

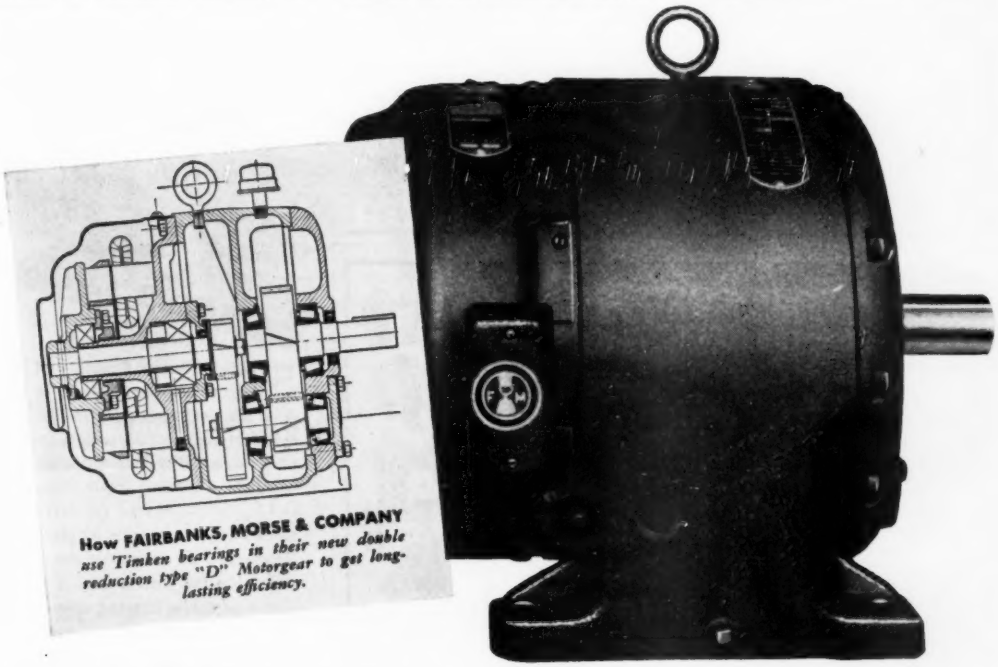
The gear teeth stay in close, precise mesh because the shaft is kept in rigid alignment by the Timken® tapered roller bearings it's mounted on. Timken bearings take the heavy thrust loads, heavy radial loads and combinations of both at the same time. They provide precision that results in maximum efficiency in power transmission. Precision that *lasts* because Timken bearings eliminate deflection and end-play, reduce wear on moving parts.

The compact design of this new gearmotor is helped by the use of Timken bearings, too. They carry maximum loads in minimum space thanks to line contact between the rolls and races.

Users of the new double reduction type "D" Motorgear can expect long, trouble-free service from its Timken bearings. Made of tough, wear-resistant Timken fine alloy steel and manufactured to microscopic accuracy, Timken bearings normally last the life of the machine, require little maintenance.

To get all these advantages in the machines you make or buy, make sure its bearings are stamped with the trade-mark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How FAIRBANKS, MORSE & COMPANY *use Timken bearings in their new double reduction type "D" Motorgear to get long-lasting efficiency.*

POSITIVE ROLLER ALIGNMENT

Wide area contact between roll ends and rib of the cone prevent Timken roller bearings from skewing. Result: bearings roll easier, last longer.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis steels.

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TAPERED ROLLER BEARINGS

TIMKEN 1899 50 1949 YEARS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

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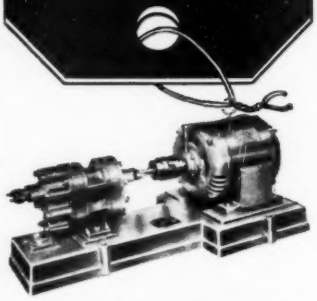
MAINTENANCE CREW *HANDS OFF!* -- it's a SIER-BATH ROTARY PUMP



Sier-Bath Screw Pumps and Gearex Pumps are designed to do a job—and keep doing it. The manufacturer has a full appreciation of the high cost of interrupting the operation of a line to permit pump repairs. On the Internal Gear-type Screw Pump, for example, the gland is the only point of attention and as this is on the suction side, it is almost negligible. It is not unusual for the packing to last two years without repacking. The pressure on the gland is so slight that it is possible to add a new ring of packing without shutting down the unit. Send for information.

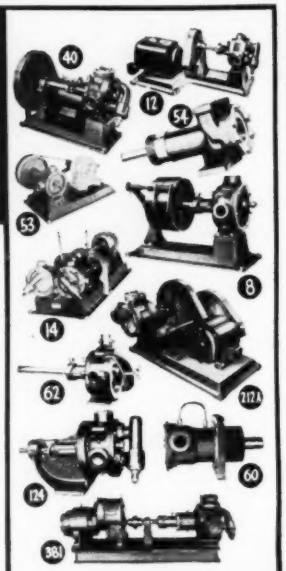
ALSO MAKERS OF SIER-BATH PRECISION GEARS

FOUNDED 1905 MEMBER A.G.M.A.

Sier-Bath GEAR and PUMP CO., Inc.

9254 HUDSON BLVD NORTH BERGEN, N J

LOWER YOUR COSTS
By Using The Right
VIKING PUMP FOR YOUR JOB



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The Viking line assures you of the correct pump. No wasted power . . . no need to accept a pump not quite designed for your work . . . or one a little too small . . . or one a little too large.

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AN HONORED NAME IN PUMPING

They are built to fit YOUR job. Ask for free folder 495W today.

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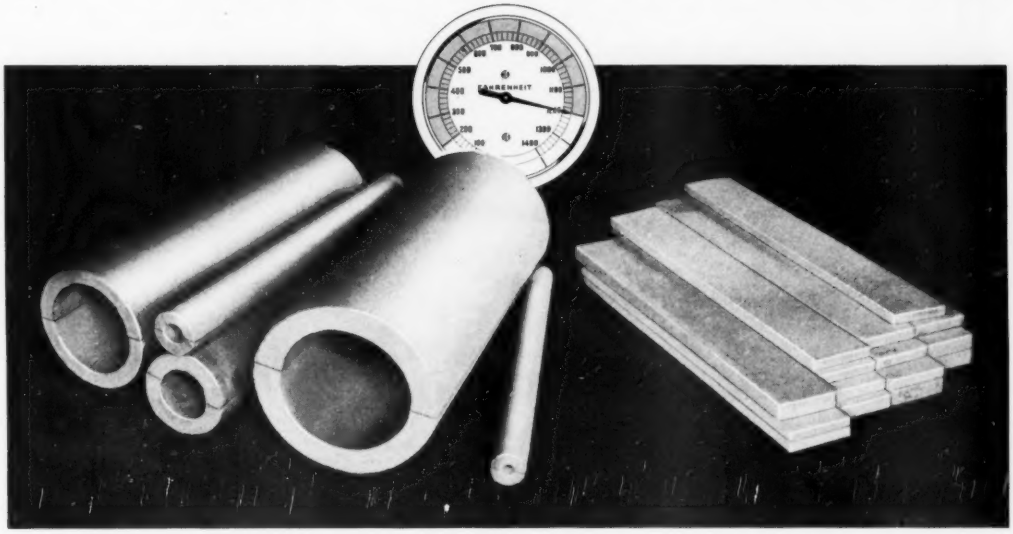
Viking PUMP COMPANY
Cedar Falls, Iowa

ONE MATERIAL INSULATES A 200°F.-1200°F. TEMPERATURE RANGE



KAYLO HEAT INSULATING BLOCK can be easily sawed, cut and scored with standard tools. Cement, cloth or other outer finishes can be applied with minimum effort. Finished jobs have a neat, clean appearance.

KAYLO PIPE INSULATION is produced in Simplified Dimensional Standards of thicknesses and diameters for snug layering, when necessary. Available in thicknesses from 1 to 3 inches in 36-in. sections, for pipe sizes from ½ inch to 12 inches.

Every engineer concerned with insulation problems should know about Kaylo Heat Insulating Block and Pipe Insulation. No other insulation provides such a combination of advantages.

Available in block or pipe covering form, this material is remarkably efficient throughout a wide 200°-1200° temperature range. It is strong and resistant to effects of moisture for long service. It is lightweight, easy to handle and apply.

Many types of industries have found this material ideal for their insulating needs. Get the facts now about Kaylo Heat Insulating Block and Kaylo Pipe Insulation.

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OWENS-ILLINOIS GLASS COMPANY
Kaylo Division Toledo 1, Ohio

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Owens-Illinois Glass Company
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Gentlemen: Please send me Kaylo heat insulation samples and descriptive literature.

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Just off the press, this useful new OIC catalog is crammed with facts and specifications on steel, iron and bronze valves. Demand is already large, so mail the coupon to *obtain your copy NOW!*

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Please send me a copy of the new OIC valve catalog and data book.

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Guard your costly boilers with Reliance Safety Equipment

Reliance EYE-HYE gives you high visibility for remote water gage reading

For main boilers or any liquid containing vessels, EYE-HYE *is the original trouble-free gage for dependable remote supervision.*

Single or double gage assemblies...alarm water columns...help you to operate efficiently, avoid water level accidents and dead-loss outage

YOU CAN DEPEND on Reliance Water Columns and Gages for completely satisfactory service on any pressure. Correct equipment is available for various ratings and applications. Here's a typical example of Reliance Equipment properly selected to meet different requirements in the same power plant operating at more than 450 psi—at the Ottawa Silica Company, Ottawa, Illinois.

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Reliance specializes in high pressure twin gage assemblies—supplies gage connections located at any angle of separation from 90° to 180°, to your specification. Consulting engineers and power men everywhere know Reliance dependability and low maintenance requirements. Ask your consultant or contact the factory for further information.

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To obtain a proper megohm reading of insulation resistance, it is necessary to provide a constant high voltage DC potential which will produce sufficient current flow through the resistor under test to actuate a means of indication.

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Model 201
Range 0-200 Megohms at 500v potential. 150 - 300 - 600 volts AC or DC.)

VIBROTEST'S EFFORTLESS *Battery-operated* power supply is the *only positive*, "push-button" means of obtaining *constant* high voltage for accurate insulation resistance measurement. Tiresome, inaccurate CRANKING ELIMINATED; No LEVELLING; No ERRONEOUS READINGS due to surface leakage; No SHOCK when disconnecting; EASY SCALE READING in ohms, megohms, AC or DC voltage; ACCURATE in —40° to 140° F. MEASURES resistance values of insulation, windings, armatures; test wiring continuity, connections; checks for shorts, leaks, opens; tests power source voltage, AC or DC—40 models covering entire range of resistance measurement from 100 to 50,000 megohms.

Valuable information on insulation resistance measurement. Contains handy reference chart showing proper ranges for general laboratory and field testing; for general industrial testing and for Research testing. WRITE for it, or use inquiry card.

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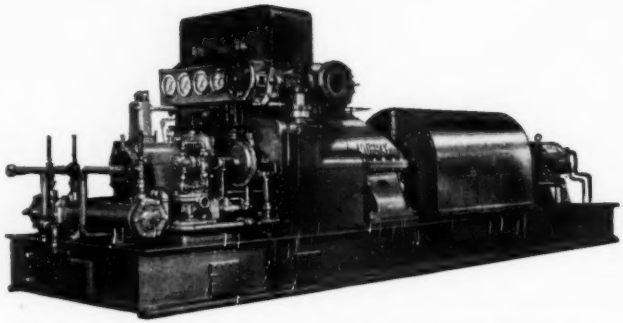
MURRAY
TYPE D
TURBO-
GENERATOR



Murray Type D turbo-generators are built in a capacity range from 500-3000 KW. Turbines are either direct-connected to 2-pole generators or operate through reduction gears connected to 6-pole generators at 1200 RPM. Direct current and 25 cycle machines are also available. This type machine is regularly furnished in the above capacity range either condensing or non-condensing and may be of the automatic extraction type or for high back pressure. Units may be mounted either on soleplates or on a fabricated steel base.

This type turbo-generator is designed to operate on steam conditions up to 600#, 750° F. TT. Auxiliary equipment normally includes combined trip throttle valve, complete pressure lubrication system including oil tank, oil filter, coolers, and automatic turbine-driven auxiliary oil pump. Gauge board with gauges, vibrating reed tachometer and necessary thermometers are also furnished.

The above photograph shows a machine of this type rated at 1000 KW. Two duplicate machines are installed in our Nation's Capitol.

Murray turbo-generators have long been noted for their rugged construction, operating economy and long life with a minimum of maintenance.

WRITE TODAY FOR FULL DETAILS

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
BUILDERS OF STEAM POWER EQUIPMENT
FOR THREE QUARTERS OF A CENTURY

POWER

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BATTERIES

Diesel cranking power you can trust . . .

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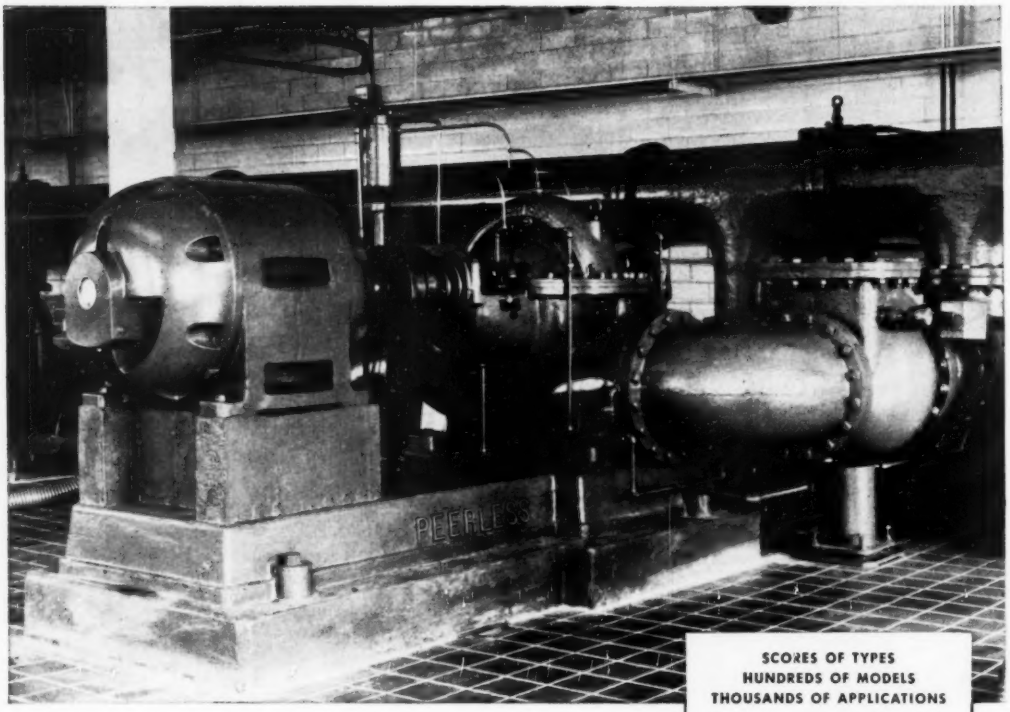
1888 . . . DEPENDABLE BATTERIES FOR 61 YEARS . . . 1949

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

PEERLESS HORIZONTAL CENTRIFUGAL PUMPS



For continuous or intermittent duty in a host of diversified services

Select the pump you need for the process you use from the diversified line of Peerless horizontal pumps. The pump shown above, a Peerless general purpose pump handling plant process water, typifies a host of efficient Peerless centrifugal pumps which are boosting output and cutting costs for manufacturers and municipalities everywhere. With its comprehensive line of horizontal pumps Peerless can handle chemicals or alkaline liquids, pump clear water or solids in suspension. There are pumps for fluids at high temperatures or they can furnish water or foam for approved plant fire protection. Peerless will move volatile butane-propane or tricky caustics and acids. Pumps are available for all practicable heads and capacities. Duty can be continuous or intermittent. Construction materials are suited to the liquid being pumped. And, backing up their installation qualified Peerless field engineering service is available in all principal cities to see that each pump matches or exceeds customer expectations. Write today for pump engineering information on your process or service. The chart at right lists a number of the types of Peerless horizontal centrifugal pump bulletins in which you will be interested.

SCORES OF TYPES
HUNDREDS OF MODELS
THOUSANDS OF APPLICATIONS

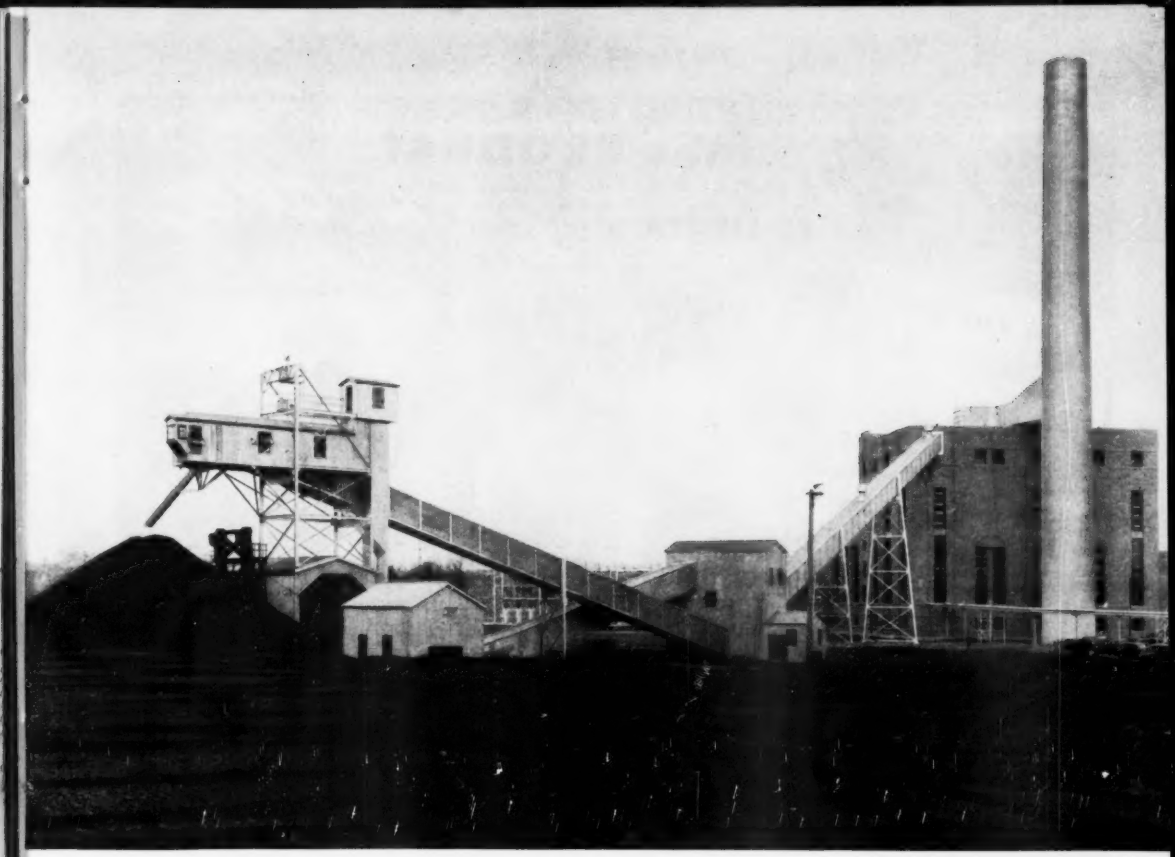
Here are a few of the services which Peerless horizontal pumps can perform. Plan with Peerless. Request copies of the Bulletins you need by Bulletin number.

Pump Service	Bulletin No.
Water Supply	B-1300
Fire Protection	B-1500
Chemicals and Oils	B-810
Vaporous Liquids	B-2201
Butane-Propane	B-2200
Boiler Feed	B-806
Sewage and Solids	B-154
Hi-Pressure	B-310
Acids and Caustics	D-2400
Process Services	B-803
All-purpose Pumps	B-2301

Peerless
VERTICAL AND HORIZONTAL
Pumps

fmc
PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Los Angeles, California — Indianapolis, Indiana
District Offices: New York 5, 37 Wall St.; Chicago 40, 4554 N. Broadway; St. Louis 8, 3908 Olive St.; Atlanta Office: Rutland Bldg., Decatur, Ga.; Omaha, Nebr., 4330 Leavenworth St.; Dallas 1, Tex., 3905 Elm St.; Fresno, Calif.; Los Angeles 31, Calif.



Central Station Coal Handling

BARTLETT-SNOW Central Station Coal Handling Equipment is adapted to receiving coal by rail, over waterways or by truck. Complete facilities are available including track hoppers; belt, apron, reciprocating and duplex feeders; belt conveyors and belt trippers; crushers, pulverizers, screens and automatic samplers; bins, bunkers and distributing conveyors dust hooded and vented if desired; also ship hoists, favored when space is limited—complete with all control equipment, synchronized and coordinated into a complete, efficient, economical unit.

At the Bryce E. Morrow Station of the Consumers Power Company near Comstock, Mich., pictured above, the cars are dumped 400 ft. from the plant, inside a sheet metal house. The coal is fed from the 18′ wide by 38′ long track hopper onto a 36″ inclined belt conveyor, with twin belt feeders, having capacities of about 100 tons per hour each, carried to the crusher house and passed over a magnetic pulley into the ring roll crusher.

Crushed coal for the bunker passes up a 325′ belt conveyor over a weightometer to a flight conveyor, enclosed in a dust-tight housing kept under suction, that distributes the coal to the bunkers with practically no dust loss at all. Coal going to storage is carried up an inclined belt, discharged to the initial pile, stored, and reclaimed through the receiving equipment.

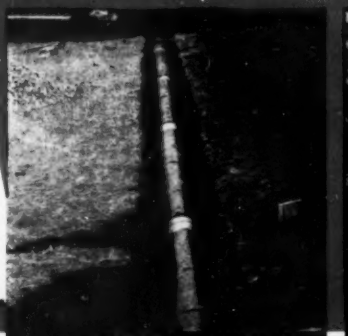
Let the Bartlett-Snow engineers with their long and exceedingly successful experience in central station coal handling, work with you on your next coal handling job. The C. O. Bartlett & Snow Company, Cleveland 5, Ohio. Engineering representatives in New York, Baltimore, Detroit and Chicago.

BARTLETT-SNOW
CLEVELAND 5, OHIO

COAL HANDLING SYSTEMS
for
CENTRAL STATIONS AND INDUSTRIAL BOILER PLANTS

The Proof of the PRODUCT is in its Performance

The Very First RIC-WIL Prefabricated Insulated Pipe Units Ever Installed Are Still Giving Trouble-Free Service After 14 Years of Constant Use



Original condition of asphalt-coated conduit.

Asphalt-coated conduit still in perfect condition.

1949: All lines functioning perfectly, trouble-free

- MINNEAPOLIS **"No trouble . . . in constant use"**
- OMAHA **"In good condition and is still serving in its original capacity"**
- DES MOINES **"No trouble . . . in first class shape"**

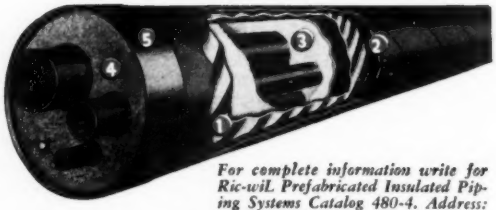
In 1935 the first Ric-wiL Insulated Pipe Units using asphalt-coated Hel-cor conduit as the outer protective housing were installed for a large products pipe line company, at Minneapolis, Omaha and Des Moines. Each of these steam lines consisted of 3" pipe insulated and enclosed in 8" conduit of standard 21' length Ric-wiL Units, with return lines laid outside the conduit.

In 1941 a check-up on these Ric-wiL Units under actual service conditions was made. Parts of the runs were excavated and a careful examination made of the conduit, fittings, etc. The Ric-wiL Units were in practically perfect condition, the same as they were when installed, with no perceptible deterioration or other damage.

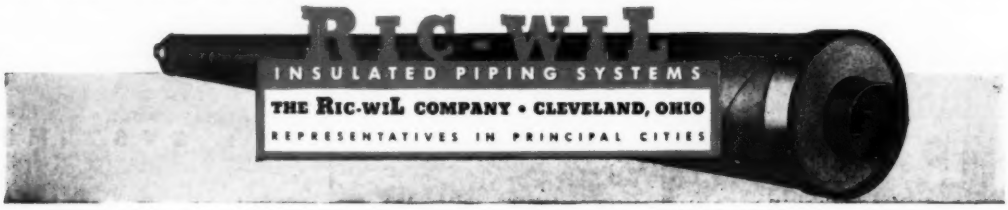
In 1949 a further check-up of all three installations was made. This investigation, as indicated by the quotations from the reports given above, showed all the lines still in constant use, functioning satisfactorily and trouble-free.

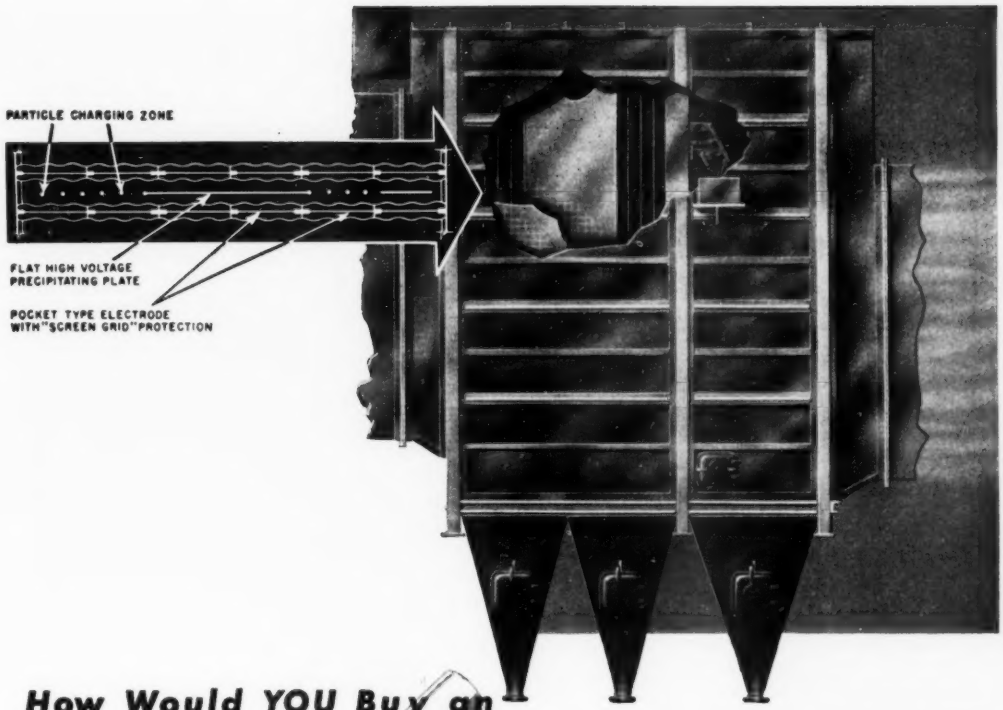
In the years since this original installation, in thousands of central heating and industrial processing projects, Ric-wiL Insulated Pipe Units, constantly improved by engineering research and development, **have continued to prove, through performance, their right to unchallenged leadership in this field.**

1. **HOUSING** of strong, shock-proof 16 gauge hot-dip galvanized Hel-cor conduit, spirally corrugated. Inside bonderized and coated with baked phenolic resin for additional protection.
2. **HIGH TEMPERATURE** asphalt coatings reinforced with tension wrapping of asphalt-saturated asbestos felt.
3. **INSULATION** of high thermal efficiency—any required type or thickness.
4. **PRESEAL RING** of steam-cured insulating cement protects units during shipping and installation.
5. **HEAVY IRON COLLAR** provides a firm foundation in making full-welded watertight field joints.



For complete information write for Ric-wiL Prefabricated Insulated Piping Systems Catalog 480-4. Address: The Ric-wiL Company, Dept. S-5.





How Would YOU Buy an

ELECTRICAL PRECIPITATOR?

The basic elements of all electrical precipitator units are fundamental. All require a shell or casing with an inlet and outlet, the charging electrodes, precipitating or collecting electrodes, some form of rapping device, and a high voltage power supply.

The design of these elements, however . . . and their application to the process of electrical precipitation, is the governing factor between mediocrity and startling success.

It is highly important then, that the specifying engineer thoroughly investigate the refinements and latest developments on these basic elements and their overall effect on operating efficiency of the precipitator he is considering.

An investigation will indicate that the Aerotec Electrical Precipitator is far advanced in the four basic steps of precipitation:

1. Charging the particle.
2. Forcing charged particle to collecting electrodes.
3. Releasing the electrical charge.
4. Deposition in storage hopper.

Aerotec high voltage electrodes are subdivided for maximum effectiveness in charging and precipitating functions. Highest precipitating force is developed between flat plates, which provide a uniform field of high intensity.

To reduce the possibility of reentrainment of particles in the gas stream, Aerotec has developed a new "pocket type" collecting electrode. This unique design insures a dead zone surrounding the electrodes for maximum efficiency on both coarse and fine dusts. Release of carbon particles by induced charge, and loss of performance due to "backionization" are reduced to a minimum by this exclusive Aerotec design. Alternate rapping of the collecting electrodes reduces emission and minimizes stack "puffing" during rapping periods.

The Aerotec electrical precipitator is an ideal secondary for the Aerotec Mechanical Design 3 RAS, a combination that assures the highest efficiency possible in dust collection . . . an efficiency that will meet the most stringent dust requirements of today . . . and tomorrow.

AEROTEC

Project & Sales Engineers

THE THERMIX CORPORATION

First National Bank Bldg. **Greenwich, Conn.**

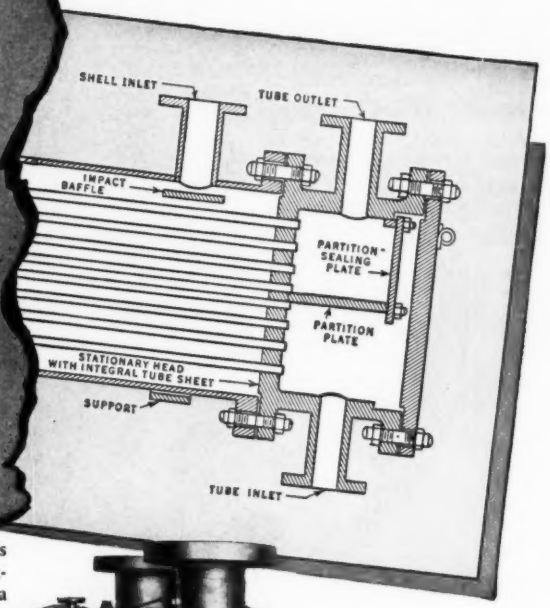
(Offices in 28 principal cities)

Canadian representative:* T. C. CHOWN, Ltd., *1440 St. Catherine St. W., Montreal 25, Quebec

THE AEROTEC CORPORATION

GREENWICH, CONNECTICUT

Leakage Between Passes Prevented in G-R FEEDWATER HEATER



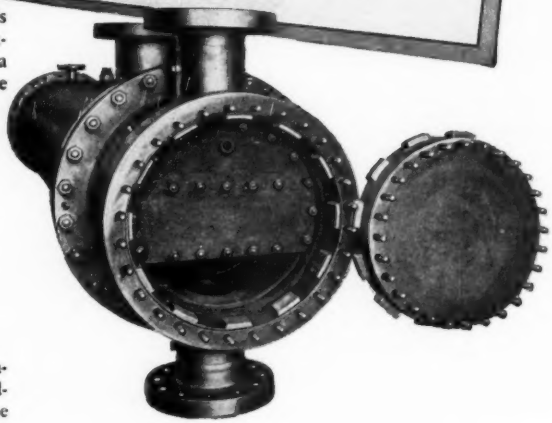
The partitions between passes in the water heads of feedwater heaters are a fruitful source of leakage that can't be detected. The head cover is a literal "iron curtain" behind which you can't see short-circuiting of water between passes.

●

Griscom-Russell offers designs of feedwater heater stationary and floating heads in which this inter-pass leakage CAN'T occur. How? By making the differential in water pressure between the passes help to keep the partition joints *tight* instead of tending to force them apart.

●

The sketches tell the story. It's one of many instances of G-R pioneering in the design of feedwater heaters. Write for bulletin describing these heaters and their many distinctive features that give you benefits you can't obtain in other feedwater heater designs.



THE GRISCOM-RUSSELL CO.
285 MADISON AVENUE, NEW YORK 17, N. Y.

GR-201

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

TOUGH LAYOUTS

- ✔ Assured Safety
- ✔ Efficient Operation
- ✔ Minimum Fuel Costs
- ✔ Low Maintenance
- ✔ Long, Trouble-Free Life

MADE SIMPLE BY NAVCO

The high degree of skill acquired by Navco Engineers from long experience in solving unusual Piping problems is your guarantee of an accurate and workmanlike Piping System.

Consult Navco for your next Piping Job

NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

No top-heavy v-belt inventory with VEELOS the link v-belt

4 reels of VEELOS replace 316 sizes of endless v-belts

● Why jam your stockroom with costly inventories of hundreds of sizes of endless v-belts when 4 reels of VEELOS will handle every v-belt job in the O, A, B and C widths? If you use only two widths of v-belts, two reels of VEELOS will be all you need.

It's a matter of record that *dollar for dollar* VEELOS gives the greatest value. Machine maintenance is kept low because uniform tension is easy to maintain. You install VEELOS *without* dismantling outboard bearings.

PUT THESE 7 VEELOS EXTRAS TO WORK FOR YOU...

- **Minimum Inventory**
- **Easy Installation**
- **Any Length Immediately Available**
- **Practically No Downtime**
- **Smooth, Vibrationless Power Delivery**
- **Long Lasting**
- **Matched Belts That Stay Matched**

VEELOS
THE LINK
V-BELT

For All the Facts and complete engineering information, measuring and installation directions—write for your copy of the Veelos Data Book.

MANHEIM MANUFACTURING & BELTING COMPANY
MANHEIM, PA.

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

Made in all standard sizes, fits all standard grooves. Packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 350 distributors throughout the country. Veelos is known as VEELINK outside the United States.

STOP BOILER FOAMING and CARRYOVER WITH

DREW *Antifoam* D

Carryover of moisture and solids with steam may be caused by improper chemical conditions in boiler water. In addition to heat losses, carryover causes steam line, superheater and turbine deposits.

DREW ANTIFOAM D controls foaming and carryover at all pressures, including the high pressures encountered in modern boiler design. When combined with Drew Organics, sludge adherence and feedline deposits are also eliminated. It is economical and simple to use.

Your local Drew engineer is available to discuss all aspects of water treatment and related problems.

POWER DREW CHEMICALS

E. F. DREW & CO. INC.

15 E. 26th ST., NEW YORK 10, N. Y.

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BOILER WATER TREATMENT
COOLING WATER CONDITIONING

Automatic Cure for Plugging of Travelling Intake Screens

Simple FOXBORO Control System operates screen whenever suction level drops . . .

HERE'S AN EASY, inexpensive way to make sure that your condenser won't overheat if excessive refuse causes sudden plugging of the travelling screen.

Foxboro Travelling Screen Control supplements periodic screen-timing with a "judgment" that's almost human. By continuous measurement of water level on each side of the screen, this sensitive control system independently starts the cleaning action whenever a predetermined safe differential is exceeded. When correct levels are again restored, it automatically shuts down screen and spray motors. In case of unusually severe fouling of the screen, the controller can also operate a warning signal.

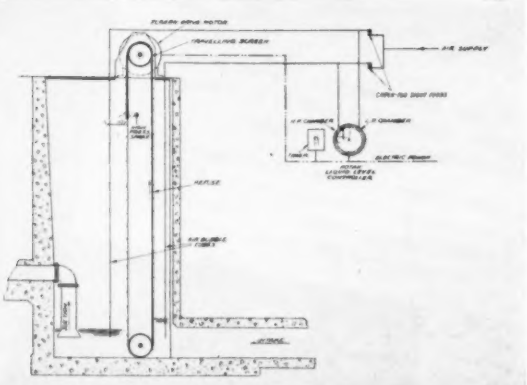
Write for complete information on Foxboro Travelling Screen Control and Bulletin 184-4 containing details of Foxboro Rotax Controllers. **The Foxboro Company, 252 Neponset Ave., Foxboro, Mass., U.S.A.**

ROTAX

Liquid Level Controller

The "heart" of Foxboro Travelling Screen Control. An extremely simple, positive-operating controller that translates level differential into operation of motors. In addition, it can operate a warning horn or light in case of unusually severe plugging.

Exclusive Rotax features include: positive electrical contact; special lock-up circuit which eliminates chattering of control relays; constant brush pressures; self-cleaning platinum contact surfaces; easy setting of control point; and freedom from maintenance.

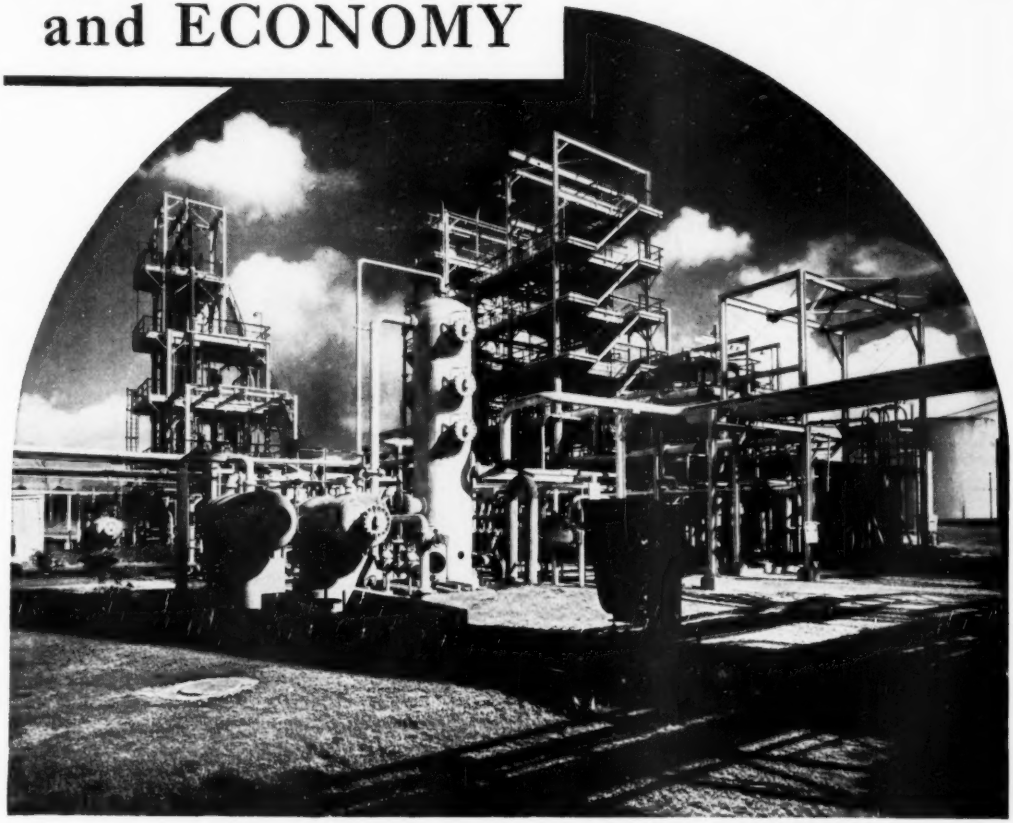


SCHEMATIC DIAGRAM, left, shows simplicity of Foxboro Travelling Screen Control System. Water level differential through the screen is continuously measured by bubble tubes. The Foxboro Rotax (electric) Controller starts and stops the screen and spray motors, as required to maintain safe differential.

FOXBORO REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING **INSTRUMENTS**

EFFICIENCY and ECONOMY



IN the planning and execution of expansion programs, Stone & Webster Engineering Corporation offers to industrial organizations the efficiency and economy resulting from a competent and coordinated engineering and construction staff with broad experience in all phases of design and construction.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

Klipfel

AUTOMATIC REGULATING VALVES

NOT LOOKING FOR TROUBLE ...BUT ABLE TO TAKE IT!

● Yes, Klipfel Float Valves are dependable; on the job at all times, assuring reliable constant liquid level control. Illustrated is type No. 77, especially recommended wherever a tight-closing float valve is required for an open tank, supplied with water at low or high pressure. Also available as a lever valve, No. 773.

Other types of float valves, single or double seated, for other uses, are described and illustrated in Bulletin No. 344. Complete with construction details, dimensions, weights, applications, etc.

Klipfel Automatic Regulating Valves are sold through wholesalers everywhere.

KLIPFEL VALVES, INC.

Hamilton, Ohio

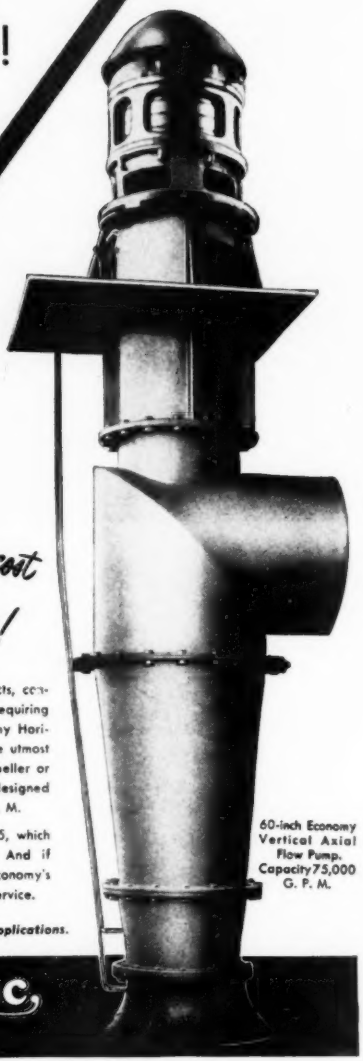
Write Dept. BC-10 today, for your copy of Bulletin No. 344.

ECONOMY... for low cost BIG VOLUME pumping!

● For drainage, irrigation, flood control projects, condenser water circulation, and other services requiring the pumping of large volumes of water, Economy Horizontal and Vertical Axial Flow Pumps afford the utmost in low cost operation. Available with either propeller or mixed flow runners. Heads from 5 to 70 feet, designed to handle capacities from 500 to 150,000 G. P. M.

Address Dept. BC-10 for Catalog No. G845, which offers complete information on standard units. And if your problem is a special one, remember that Economy's staff of hydraulic engineers is always at your service.

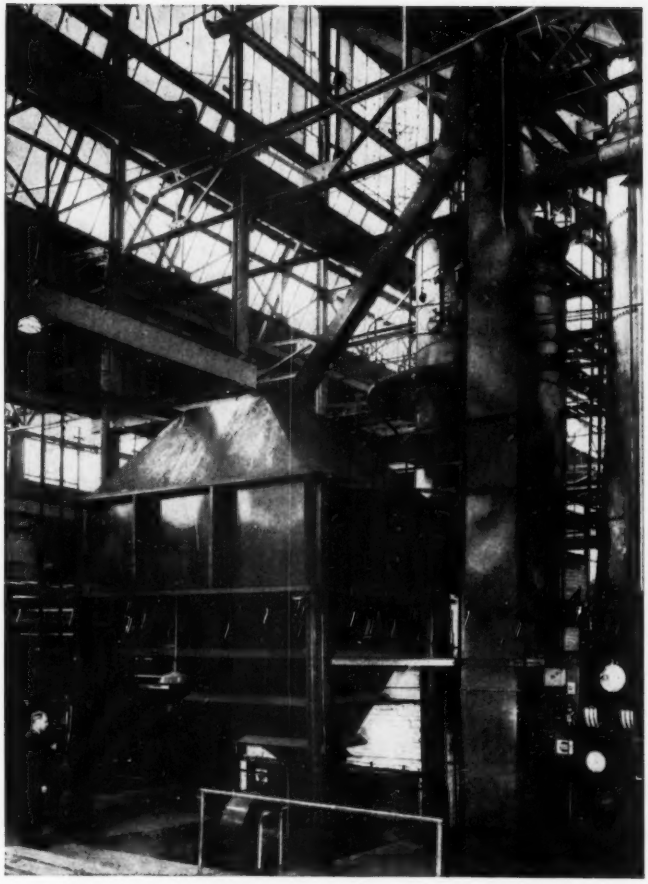
Centrifugal, axial and mixed flow pumps for all applications.



60-inch Economy Vertical Axial Flow Pump. Capacity 75,000 G. P. M.

Economy Pumps Inc.

HAMILTON, OHIO



A single large Vulcan Ramfeed Stoker fires this 450 H.P. Wickes Vertical Waste Heat Type Boiler — automatically maintaining heat over week-end shutdowns with no attention.

"We switched from oil and gas to Canton Stoker fired coal and saved 2/3 of our former fuel cost"

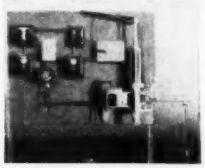
...says the well satisfied plant manager of Babcock Printing Press Corporation, Canton, Ohio

Building the gigantic, modern Babcock Rotary Printing Presses that print a whole magazine in four colors requires a huge high ceilinged plant, plus uniform temperatures for proper fitting of precision parts.

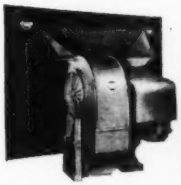
Both oil and gas were tried, but the cost proved excessive ... temperatures varied too much for precision work. CANTON'S Engineers were then called in on the problem, and a complete stoker and coal handling system were installed on their recommendations. In the *first* heating season, the installation saved considerably more than its cost, *returning a substantial profit on the investment* and paying added dividends in improved working conditions.

Consult a Canton Field Sales Engineer (in principal cities) and find out how CANTON STOKERS can help you with your heating or power problem. No cost or obligation is involved. Or write or wire direct to CANTON STOKER CORP., 741 Andrew Place S. W., Canton, Ohio.

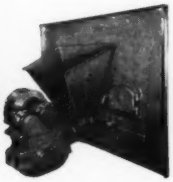
"Turbo-Aire" Jets—for smoke abatement, firing efficiency.



Synchronized Combustion Control Systems — for all boilers.



Vulcan Ramfeed Stokers —for loads up to 800 H.P.



LoSet Ramfeed Stokers— for loads up to 350 H.P.

Duraflex Wormfeed Stokers—for loads up to 175 H.P.

CANTON STOKERS

CANTON STOKER CORPORATION

741 ANDREW PLACE S. W., CANTON, OHIO

Gentlemen:

---Please send all descriptive literature at once

---Have a CANTON Engineer interview us immediately

Name _____

Company _____

Address _____

City _____ State _____

Struthers Wells Feedwater Heaters

This installation practice saves space and piping, and is being widely used.

To show the important features we had to photograph this low pressure feedwater heater before installation. When installed, the two rings on the shell will be welded into the condenser neck, between the turbine and the main condenser, leaving only the ends of the heater protruding. The steam inlet, with its partial belt to provide uniform, low velocity distribution of the incoming steam, will be hidden inside the condenser neck.

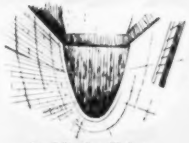
The use of the welding rings avoids any heat distortion of the heater shell when field welding to the condenser neck, and also provides easy insertion of the heater. Write for informative, technical bulletins.

STRUTHERS WELLS CORPORATION
Process Equipment Department
WARREN, PENNA.
PLANTS AT WARREN, PENNA. · TITUSVILLE, PENNA.
OFFICES IN PRINCIPAL CITIES

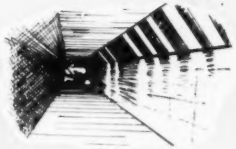
WHERE TO USE LUMNITE IN POWER PLANTS

Steel Stack Linings

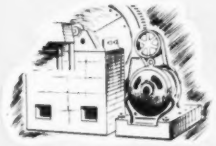
Ash Pit and Cinder Catcher Linings



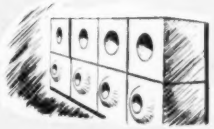
Coal Bunker Linings



Flue and Duct Linings



Overnight Structural Concrete



Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

FOR RAPID REPAIRS

SAVE TIME, CUT COSTS

with a CASTABLE REFRACTORY

Quickly adaptable to any size, shape or thickness, Castable Refractories made with Lumnite* are economical first aid for emergency repairs.

For baffles, furnace walls, arches, door linings, you get one-piece refractories that reduce heat loss, prevent infiltration of outside air. No shrinkage to bother about. High spalling resistance. Low upkeep.

They're easy to use, too. Add water to the packaged mixture, cast it in place or in a simple form or mold. Large jointless sections are as easy to cast as small special shapes. There's no cutting or fitting. And rapid hardening Lumnite Castables are ready for service in twenty-four hours or less.

You get time-saving, adaptable construction and long, durable service when you specify a Castable Refractory made with Lumnite. You get a balanced, tailor-made refractory that results from the blending of selected materials. You get suitable refractory aggregates with cold-setting, high-strength binder, Lumnite. Castables to meet different temperature and insulation needs are made by manufacturers of refractories and sold by their distributors. For further information, write to Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Bldg., New York 17, N. Y.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

P-L-18

Lumnite Division

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL CORPORATION SUBSIDIARY

135 EAST 42nd STREET • NEW YORK 17, N. Y.

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

IF IT ISN'T ACCURATE IT ISN'T SIMPLEX

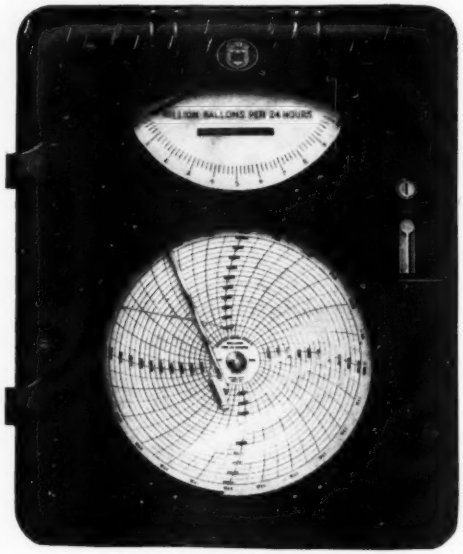
We of Simplex believe the discerning engineer requires accuracy above all other things in any instrument he purchases. If the word "Simplex" could be translated into modern language it could well mean accuracy, for that is the primary feature of all products bearing this name. While we are concerned with long life, continuous operation, and modern appearance, we nevertheless stress and stress again the most important point of all — accuracy. In presenting the type H meter, we confidently offer to the industry an instrument which fulfills this feature to an extremely gratifying degree.

NEW TYPE H METER

Most accurate yet developed within its flow range

ACCURATE within ± 2% at any point over flow ranges up to 10 to 1, the meter is designed for:

- Use with Venturi Tube, Flow Nozzle, or Orifice Plate.
- Measurement of hot or cold water, process liquors or gases.
- Outdoor or indoor mounting, using the same instrument for both conditions.
- Inclusion of three vital measuring elements—indicator, recorder, and totalizer.
- Wall bracket, instrument panel, or floor mounting as desired.
- Even spacing of the indicator dial and recording chart graduations for ease of reading at high or low flow rates.
- Testing in place at any time with an easily applied manometer test device.
- Change of differential pressure maximum by use of a different float without change of cylinder.
- Maximum differentials of 114" or 64" of water as desired.

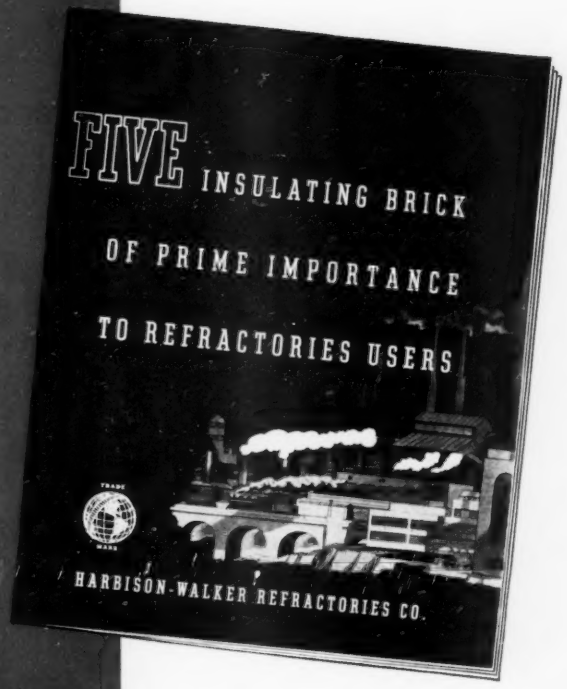


Write for Bulletin No. 400 to
Simplex Valve & Meter Company, Dept. 10
6780 Upland Street, Philadelphia 42, Pa.

If it isn't ACCURATE it isn't SIMPLEX

SIMPLEX
VALVE AND METER COMPANY

HERE'S A FREE *DATA BOOK* EVERY FURNACE MAN SHOULD HAVE



Thermal data and heat-loss figures for the various grades and combinations of Harbison-Walker insulating fire brick are given in this DATA BOOK. These refractories are made in five brands, each suitable for a definite maximum temperature.

In developing them Harbison-Walker has achieved a practical balance between strength and thermal efficiency, through extensive research and service experience.

We will be glad to send you a copy of this free technical bulletin for your files.

HARBISON-WALKER REFRACTORIES CO.

AND SUBSIDIARIES

General Offices, Pittsburgh 22, Penna.

Trade Mark Reg.

World's Largest Producer of Refractories

Harbison-Walker Refractories Co.
Pittsburgh 22, Penna.

Gentlemen:

Please send me a copy of your Data Book, FIVE INSULATING BRICK.

Name _____ Title _____

Company _____

Address _____

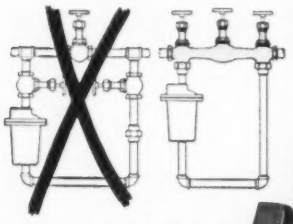
In power or process piping, you'll

SAVE

WITH THE

money
space
maintenance
weight
time

BELFIELD BYPASS



Outmoded set-up at left uses 18 threaded joints . . . Belfield Bypass uses only eight.

THE Belfield Bypass is a completely assembled and ready-to-use unit . . . compact and convenient. It eliminates from eight to fourteen threaded joints . . . with the usual leakage and maintenance . . . and affords continuous, trouble-free operation.

Yet it costs no more than the assortment of valves, nipples, fittings, unions and pipes (plus the cutting, threading and assembling) that you may be using now. The Belfield Bypass is available in Bronze, Iron and Steel . . . for pressures up to 300 lbs. . . . with screwed or flanged ends.

Call in your local Honeywell engineer for detailed information on this bypass and such other Belfield products as: Hi-Lift Hand Control Valves, Transfer Valves, Low Lift Diaphragm Control Valves, Liquid Level Devices and Steam-Jacketed Rotary Cocks.

BELFIELD
MH WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL MH
VALVES

Write, today, for a copy of Bulletin #254-1

MINNEAPOLIS-HONEYWELL REGULATOR CO.
BELFIELD VALVE DIVISION
Philadelphia 44, Pa.
Offices in 73 principal cities of the United States, Canada and throughout the world

MINNEAPOLIS Honeywell *Process Control Specialties* Belfield VALVES

QUESTION:

Which Garlock packing should I buy for general use on Valve Stems?

ANSWER:

Garlock 117

GARLOCK 117 Valve Stem Packing, furnished either braided or twisted in all sizes from $\frac{1}{16}$" to $\frac{3}{4}$", advancing by sixteenths. Packaged on 1-lb., 2-lb. and 5-lb. spools.

Yes, GARLOCK 117 is specially recommended for general use on valve stems because it gives unusually long and dependable service.

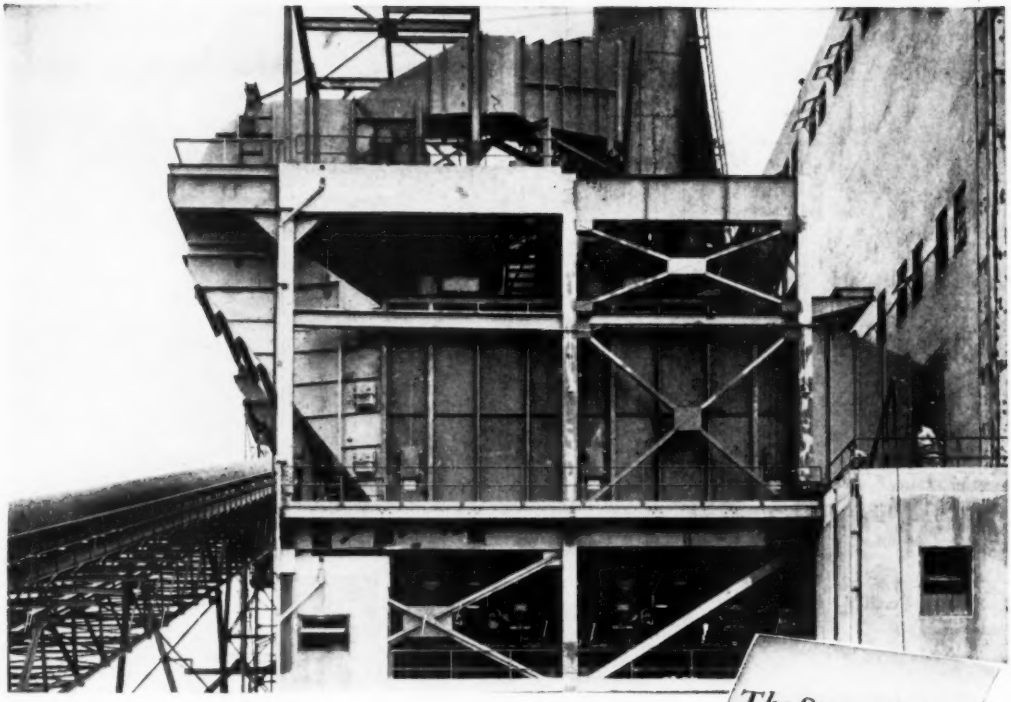
GARLOCK 117 Valve Stem packing is made from long fibre asbestos yarn, thoroughly lubricated with a special Garlock heat-resisting compound and graphited. It is equally effective against steam at medium or low temperatures, hot or cold water and most aqueous solutions.

Like all Garlock products, GARLOCK 117 is quality controlled from raw material to finished product to insure uniform fine quality and superior performance.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK PACKINGS, GASKETS AND OIL SEALS



The Story Behind
KOPPERS-ELEX
Performance
GUARANTEE

How to get MAXIMUM Nuisance Abatement!

KOPPERS-ELEX electrostatic precipitators, like those in this installation, provide maximum *guaranteed* nuisance abatement . . . and improve public relations by helping make your community clean and healthy.

Although fly ash emitted to the atmosphere may vary from 0.75 to 0.25 grains per cubic foot under municipal ordinances . . . these results do not provide nuisance abatement that meets public demand. But Koppers-Elex can limit residuals to *.15 grains or less*, uniformly emitted . . . a *guaranteed* performance which protects your interests *now and in the future* by providing maximum nuisance abatement under all conditions!

Koppers-Elex precipitators assure you of *maximum efficiency* and *performance as guaranteed* . . . results of the experience gained in over 1000 successful applications. So, for superior recovery or removal of material from industrial gases, specify Koppers-Elex . . . *designed, engineered, built, installed and guaranteed* by Koppers . . . *with 111 years of reputation-building integrity behind it.* Koppers Co., Koppers-Elex Precipitator Dept., 230 Scott St., Baltimore 3, Maryland.

1st with Industrial Gas Cleaning Equipment

Koppers-Elex
ELECTROSTATIC PRECIPITATOR

KOPPERS

APARTMENT FOR SLIME

With condenser tubes handling unchlorinated water, slime-forming bacteria never have to worry about a housing shortage. Instead, these bacteria move in, form their colonies, and the condenser tubes become apartments for slime. When this happens, the terminal log mean temperature difference rises, excess steam costs go up, and outage increases along with the labor bill for costly plug cleaning.

Chlorination, engineered by W&T and backed by 35 years' experience, has proven itself the effective answer to slime in condenser and heat exchanging equipment. It is effective because the Wallace & Tiernan De-Sliming Process attacks the cause of slime, bacteria, and "evicts" these unwanted "tenants" from their home in your equipment.

CD-32

Regardless of whether yours is an open or closed cooling system or whether you use shell and tube, trombone, or open box condensers, Wallace & Tiernan engineering plus time-tested W&T Chlorinators can put all the money-saving advantages of slime control by chlorination to work on your condensers or heat exchange equipment.

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PRODUCTS, INC.

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Again! "BIG ANGLES" AID CONSERVATION

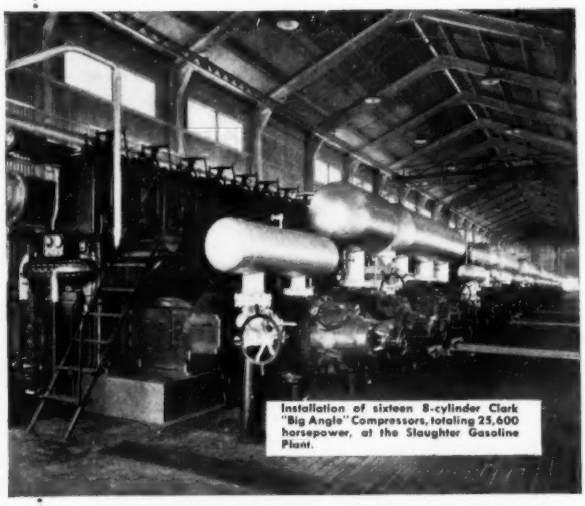
At the new Slaughter Pool Natural Gasoline and Gas Conservation plant*, Clark "Big Angle" Compressors are a vital part of a major conservation project. These units make up the largest compressor installation in the natural gasoline industry.

The plant is designed for the production of natural gasoline, butane and propane—from gas formerly burned off as flare gas. In addition, the dry residue gas is sold to a gas pipe line company for use as fuel.

Sixteen 8-cylinder "Big Angles", rated at 1600 BHP each, are used to compress about 90,000,000 cubic feet of "casing-head" gas per day from 13.2 psia to 713 psia in three stages—at a plant elevation of 3,000 feet.

The Clark "Big Angle" Compressors are aiding conservation by meeting the Oil Industry's needs for high-powered, heavy-duty, Gas-Engine-Driven Units. The BA has a wide operating range and is the most accessible for servicing of any compressor . . . saves money on both maintenance and installation costs.

25,600 Clark "Big Angle" Horsepower Serves Major Conservation Project at Slaughter Pool, Texas



Installation of sixteen 8-cylinder Clark "Big Angle" Compressors, totaling 25,600 horsepower, at the Slaughter Gasoline Plant.

WRITE FOR BOOKLET

For complete description, dimensional drawings and other useful data, on "Big Angle" Compressors, send for Bulletin B-A.

CLARK BROS. CO., INC. • OLEAN, NEW YORK

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*THE SLAUGHTER PLANT IS OWNED BY: Stanolind Oil and Gas Company; The Texas Company; Honolulu Oil Corporation; Magnolia Petroleum Company; The Devonian Company; The Atlantic Refining Company; Saltmount Oil Company; Mid-Continent Petroleum Corporation.

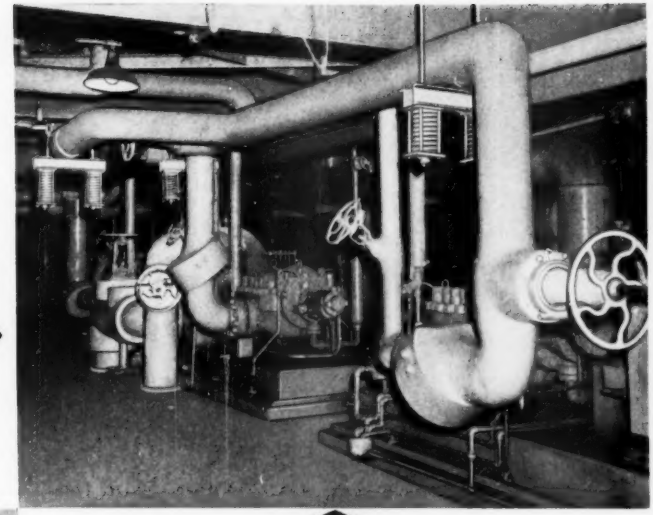
CLARK ONE OF THE DRESSER INDUSTRIES **"BIG ANGLE" COMPRESSORS**

ILLUSTRATION SHOWS

PENNSALT

APPLICATION OF UNIBESTOS IN NEW WYANDOTTE, MICHIGAN POWER PLANT ON HIGH-PRESSURE, CENTRIFUGAL BOILER FEED PUMPS.

Insulation Contractor:
G. H. GOTSHALL CO.
Detroit, Michigan



Consider these
UNIBESTOS
advantages:

- High physical and chemical stability.
- High resistance to deterioration at high temperatures.
- High structural strength.
- High resistance to moisture, even repeated water saturation.
- High resistance to shock or vibration.
- Low thermal conductivity.

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UNIBESTOS PIPE COVERING

The ease of cutting, fitting and stripping of UNIBESTOS Single Layer Construction speeds application, assures substantial saving in time and labor costs. Breakage, too, on the job or in transit, is eliminated. UNIBESTOS also offers the added advantage of re-use. Where pipe inspection is necessary, UNIBESTOS is easily removed and replaced.

UNIBESTOS No. 750 is suitable for temperatures up to 750° F. No. 1200 or Combination are recommended for temperatures up to 1200° F. These temperature ranges permit the use of one material at maximum efficiency for a wide variety of purposes. Unibestos is available in half sections up to 30" pipe diameter, in quadrants up to 60" diameter, and in cylindrical form where specified. UNIBESTOS No. 750, No. 1200, and Combination are all furnished in single layer construction.

UNION ASBESTOS & RUBBER COMPANY
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Please send illustrated folder showing sizes, prices, conductivity curves and technical information to

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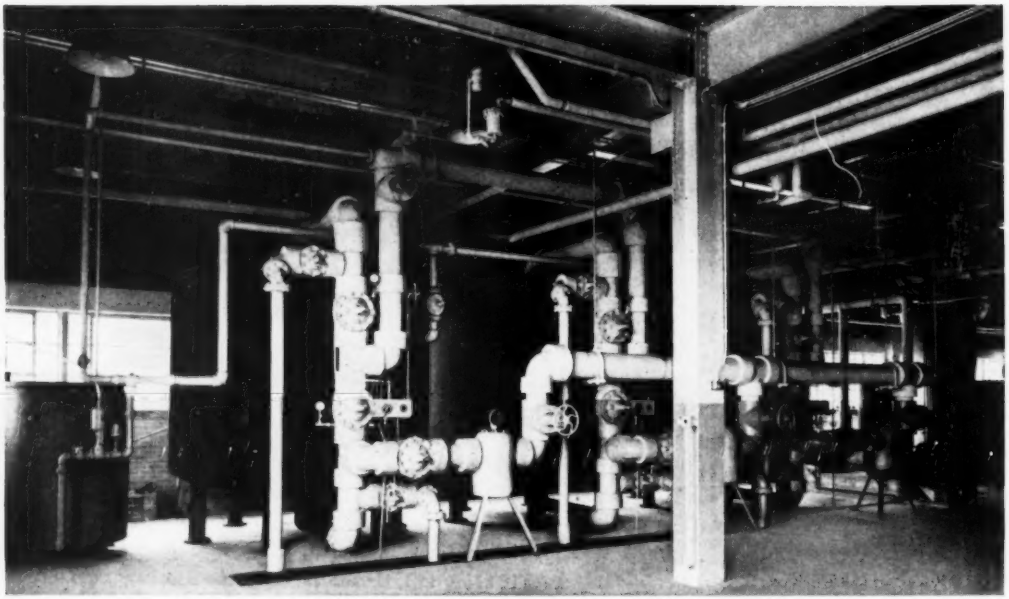
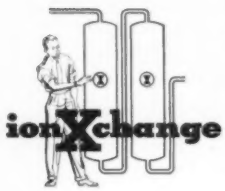
Name_____ Title_____

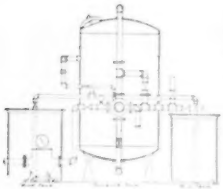
Soft Water: 60,000 gallons per hour at Western Electric Co., Allentown, plant



Pilot-controlled triplex ILLCO-WAY softener in Western Electric Co. plant at Allentown, Pa. Flow rate: 500 gpm for each of three softener units.



The above ILLCO-WAY triplex softener, semi-automatically controlled, produces a peak of 60,000 gallons per hour of softened water for chemical operations associated with vacuum tube manufacturing and for boiler feed make-up at the new Allentown, Pa., plant of Western Electric Co., Inc. Water produced is free of hardness and scale-forming properties. Its use assures the water purity required for manufacturing operations and reduces chemical after-feed treatment of the boiler water and costly shutdowns for cleaning. An ILLCO-WAY *Softener* was chosen for this installation because of the low-pressure boiler operation requirements and the low solids content of the raw water supply.



ILLCO-TEMP SOFTENER easily added to hot lime-soda water softener. Unit operates economically and continuously at temperatures as high as 250° F or higher . . . on waters having a pH as high as 10.5.

Under other conditions . . . De-alkalizing units for use when water is high in alkalinity and boilers operate at intermediate pressures; ILLCO-WAY De-ionizing units for use with high-pressure boilers requiring pure feedwaters.

ILLCO-TEMP SOFTENER . . . for removal of residual hardness from the effluent of hot or cold lime-soda units—without chemical after-treatment. Chemical savings from this alone will normally pay for equipment in less than 2 years. Reduction of effluent from lime-soda units to "zero" hardness produces real operating economies. Scale-forming salts are eliminated. No after-precipitation in the lines, pumps, pre-heaters, or the boilers themselves.

ILLCO-WAY

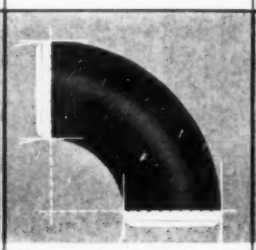
DE-IONIZING
DE-ALKALIZING
SOFTENING

ILLINOIS WATER TREATMENT CO., 853-10 Cedar St., Rockford, Illinois • 7310-NN-10 Empire State Bldg., New York City

What do YOU want in a welding fitting?

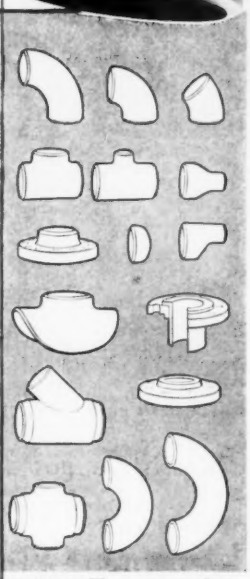
These *PLUS* features are combined in WeldELLS and other Taylor Forge Welding Fittings.

Seamless—No question about soundness in a fitting that is forged and formed seamless.



Tangents—Keep weld away from zone of greatest stress—simplify lining up.

Precision quarter-marked ends—Expedite layout; insure accuracy. A constructive refinement.



Full line—The most complete line of welding fittings and forged steel flanges in the world—greatest range of types, weights, sizes.

Complete identification—Permanent type; saves time; prevents errors.

Wall thickness never less than specification minimum—Assures full strength and long service life.

Machine tool beveled ends—Provides *the best* welding surface; accurate bevel and land.

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☐ Please send new catalog 484 covering welding fittings and forged steel flanges.

☐ Send new Bulletin 493 covering Taylor Spiral-Weld Pipe and related fittings.

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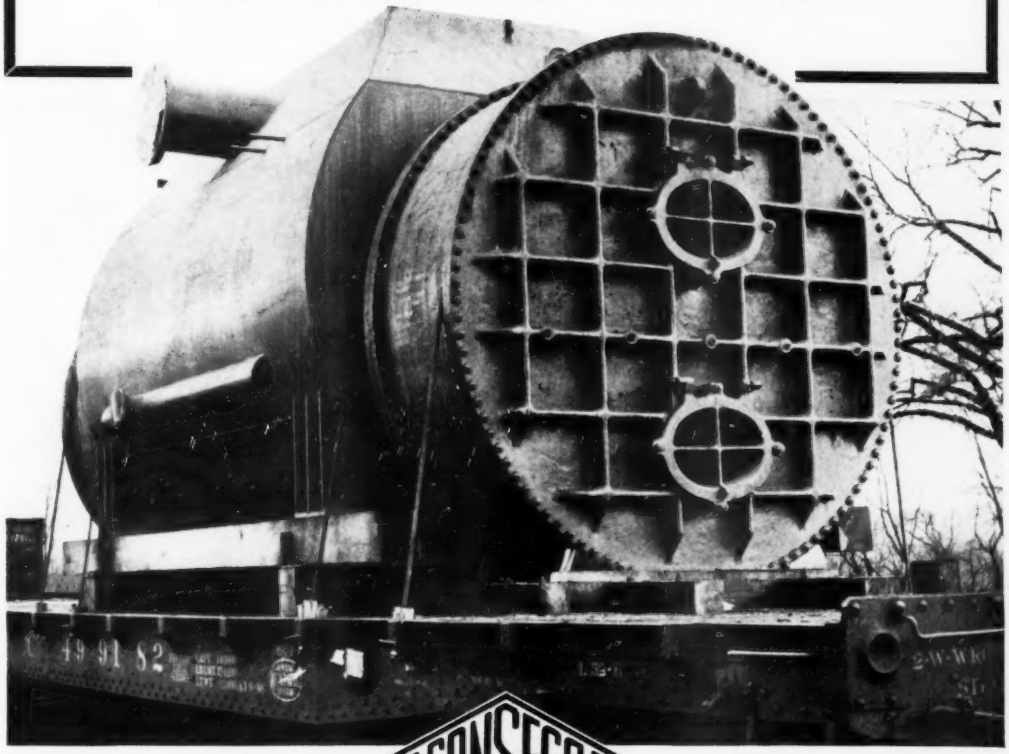
New fact-filled catalog will be sent to anyone requesting it on company letterhead.

ONE OF THREE CONSECO CONDENSERS

now in operation...in Mexico



CONSECO

Photograph taken of one of the CONSECO units en route to the plant of Ebasco International Corporation in Mexico.

Three of these units of 11,300 sq. ft. each have now been in operation several years. Each unit is a 2-pass non-divided flow type.

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It will be to your advantage to consult CONSECO on your requirements. No condenser designed and built by us has failed to fully meet or exceed guarantees. Successful design and extensive experience over a period of more than twenty years have demonstrated our equipment. And there is always the possibility of our low bid saving your company money. Consult us TODAY!

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. . . IN EVERY TEST!

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A packing that doesn't fit accurately on a compressor can mean loss of power . . . loss of maintenance time. That's why Quaker Packings are pre-tested as many as 18 times to assure satisfactory performance in every installation wherever they are used throughout the Power Industry.

Measuring for accurate size is just one of the many tests Quaker Packings go through before leaving the plant. Each and every test is designed to safeguard the performance of these packings when they are put into use. Pre-tests that assure long, trouble-free operation . . . freedom from unnecessary breakdowns and loss of equipment.

To keep power equipment on the job, specify Quaker Pre-Tested Packings! They lubricate correctly . . . stay soft and pliable . . . help reduce rod and shaft replacements.

HOSE THAT LASTS

. . . because it has been pre-tested to stand pressure and resist wear. Quaker Hose is available for use with air, water, steam, volatiles, acids and gases.

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Incorporated in Consolidated Maxiflow Safety Valves are design and performance advantages that are the results of over 70 years of valve manufacturing experience.

MAJOR FEATURES INCLUDE—

The Thermodisc—Designed to permit rapid equalization of temperature differentials set up when a high-pressure safety valve reseats after blowing. Thermal stresses are minimized. Seat distortion cannot take place. Permanent tightness is achieved.

Mechanical Through Bushing—Precision machined surfaces provide constant entrance conditions for steam flow. Eliminates leakage due to porous castings. Selection of material with high strength and creep resistance values at elevated temperatures is made possible. Added strength in the valve neck is also obtained.

Control of Blowdown—The Maxiflow has been specifically designed to function with a blowdown as low as one (1) per cent. The exclusive "micrometer" trim ring provides a simple and practical chatterproof blowdown control—externally controlled and can be made with valve under pressure.

Retention of Popping Point—Change in the popping point, due to temperature difference, is held to a minimum in the Maxiflow. This is achieved by combining proper compensation with materials having low coefficients of expansion. Special alloy steel is used to obtain stability of spring support in the yoke rods, and the stainless steel spindle compensates thermally for elongation of other parts which would affect spring loading.

Consolidated Maxiflow Safety Valves are available in either welding or flanged inlet.

Pressure range is from 250# to 2500#. Temperatures to 1100° F.

For a complete description plus capacity tables, write for the Consolidated Maxiflow Safety Valve Bulletin.

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A Product of

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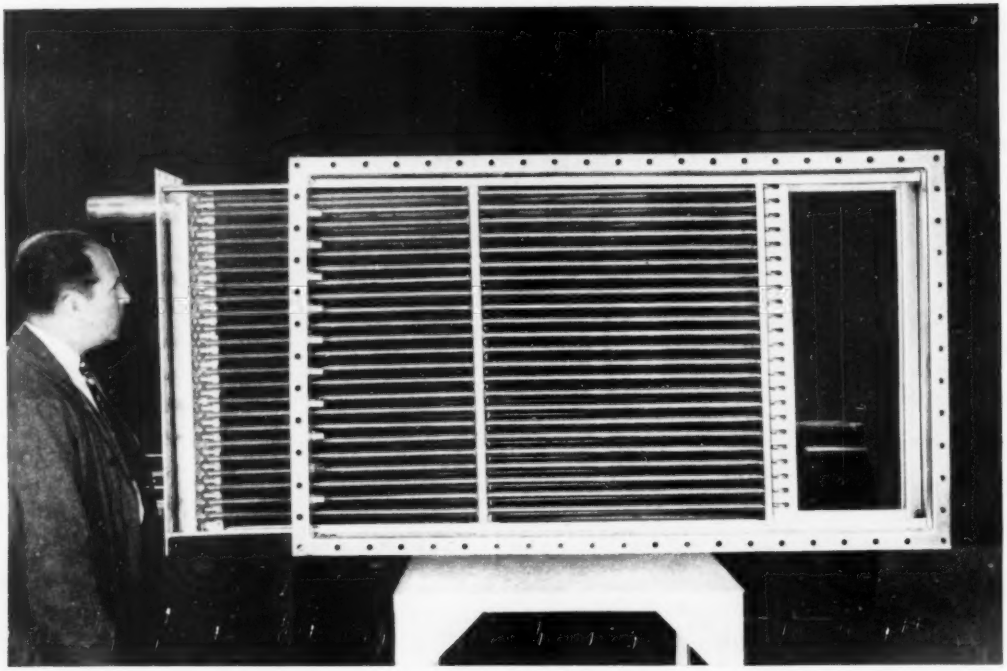
Makers of 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments, 'Hancock' Valves, 'Ashcroft' Gauges. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists, and other lifting specialties.



Perfect Score

Detroit Edison listed its specifications for high-pressure heating coils. American Blower checked them against its own Type H Heavy Duty Coils . . . and the score was perfect on every count!

Here are just a few of the winning points:

Score 1—American Blower Type H Coils are built of special materials, under rigid inspection, to operate on 350 pounds steam pressure.

Score 2—Type H Coils contain cupro-nickel tubes which resist corrosion and withstand high temperatures.

Score 3—Type H Coils have removable heating elements—a feature demanded on severe applications in heavy industry—and a feature that makes inspections possible without disturbing casing or ductwork.

A perfect score like this is still another reason why America's leading public utilities, like Detroit Edison, order and re-order American Blower Heavy Duty Heating Coils, Mechanical Draft Equipment, Fly Ash Precipitators, Gyrol Fluid Drive for boiler feed pumps and fan control equipment.

You can benefit from this wealth of experience in the power plant field by discussing your requirements with an American Blower Sales Engineer. Call him at any American Blower Branch Office. There is no obligation, of course.

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CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

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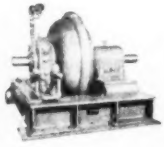
HS and Sirocco Fans for forced or induced draft in all types of power plants.

ST Fly Ash Precipitators—especially for power plants burning pulverized fuel.



Type VS Gyrol Fluid Drive—for adjustable speed control of mechanical draft fans.

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...THESE ARE OUR EVERYDAY DIET

Few concerns will tackle a job like this pipe bend though the Blaw-Knox Shop handled it with ease. The piping is forged and bored steel, 17½ inches in outside diameter with 3¾-inch walls. The flanges are 8¾ inches thick and 31½ inches outside diameter fitted with 4-inch bolts. Temperature was not a consideration on this installation but it was fabricated for a working pressure of 7700 psi and was given hydraulic tests up to 11,000 psi.

Those who have real power piping problems, bring them to Blaw-Knox Power Piping.

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DIVISION OF BLAW-KNOX COMPANY
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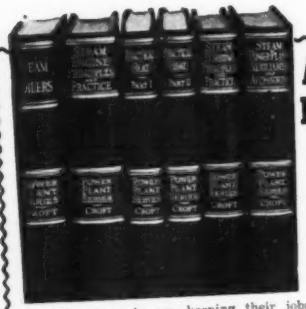

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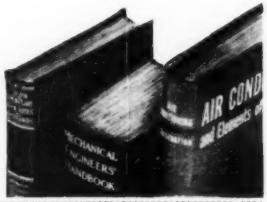

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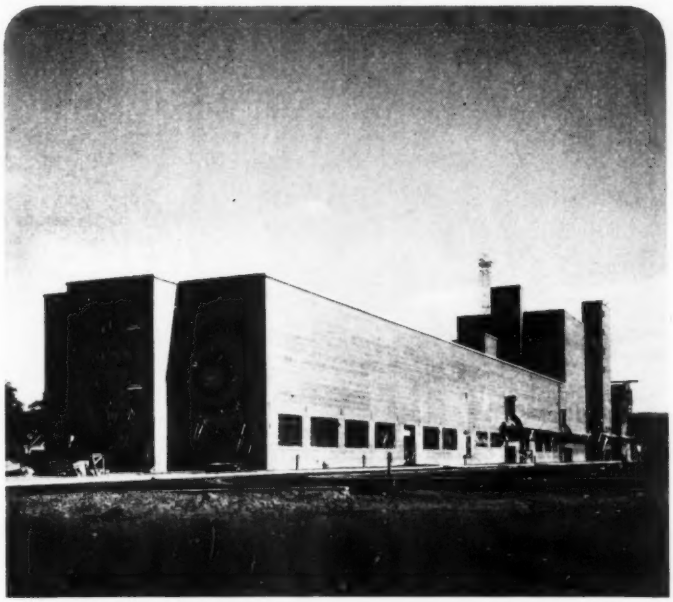

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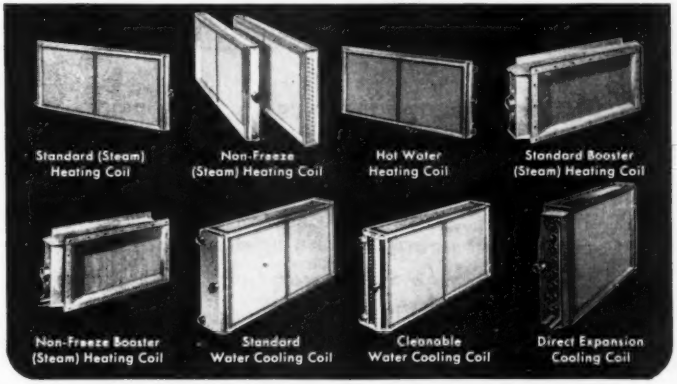
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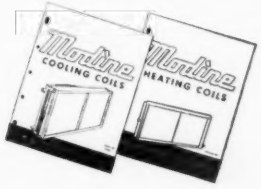

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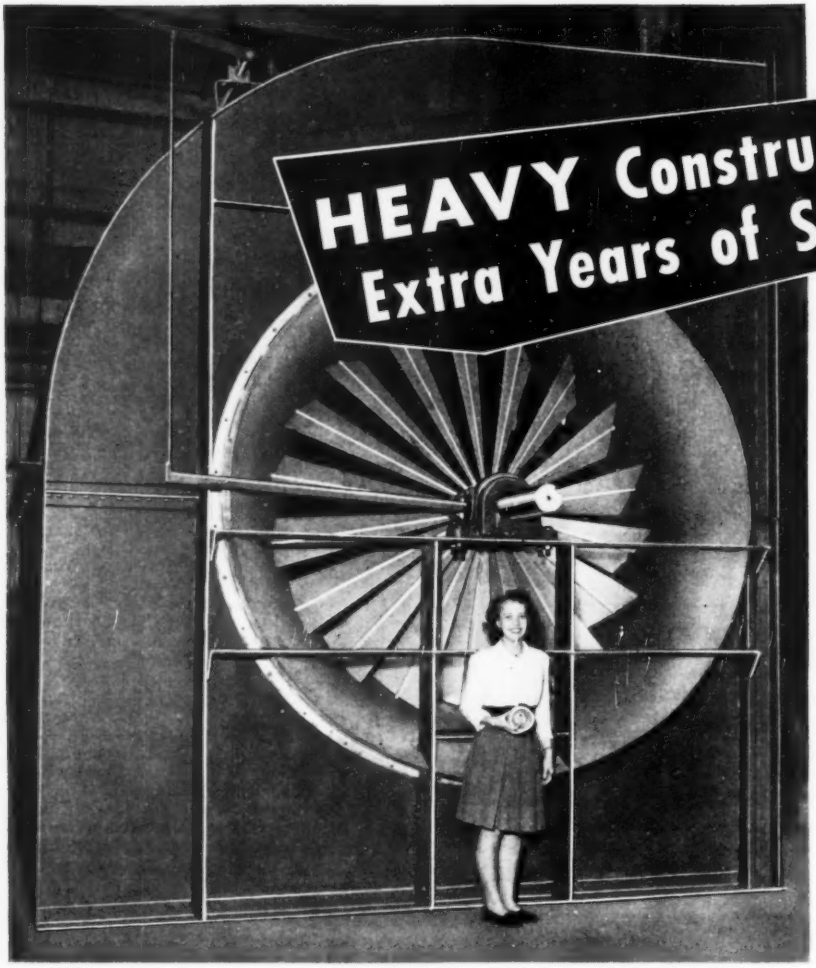

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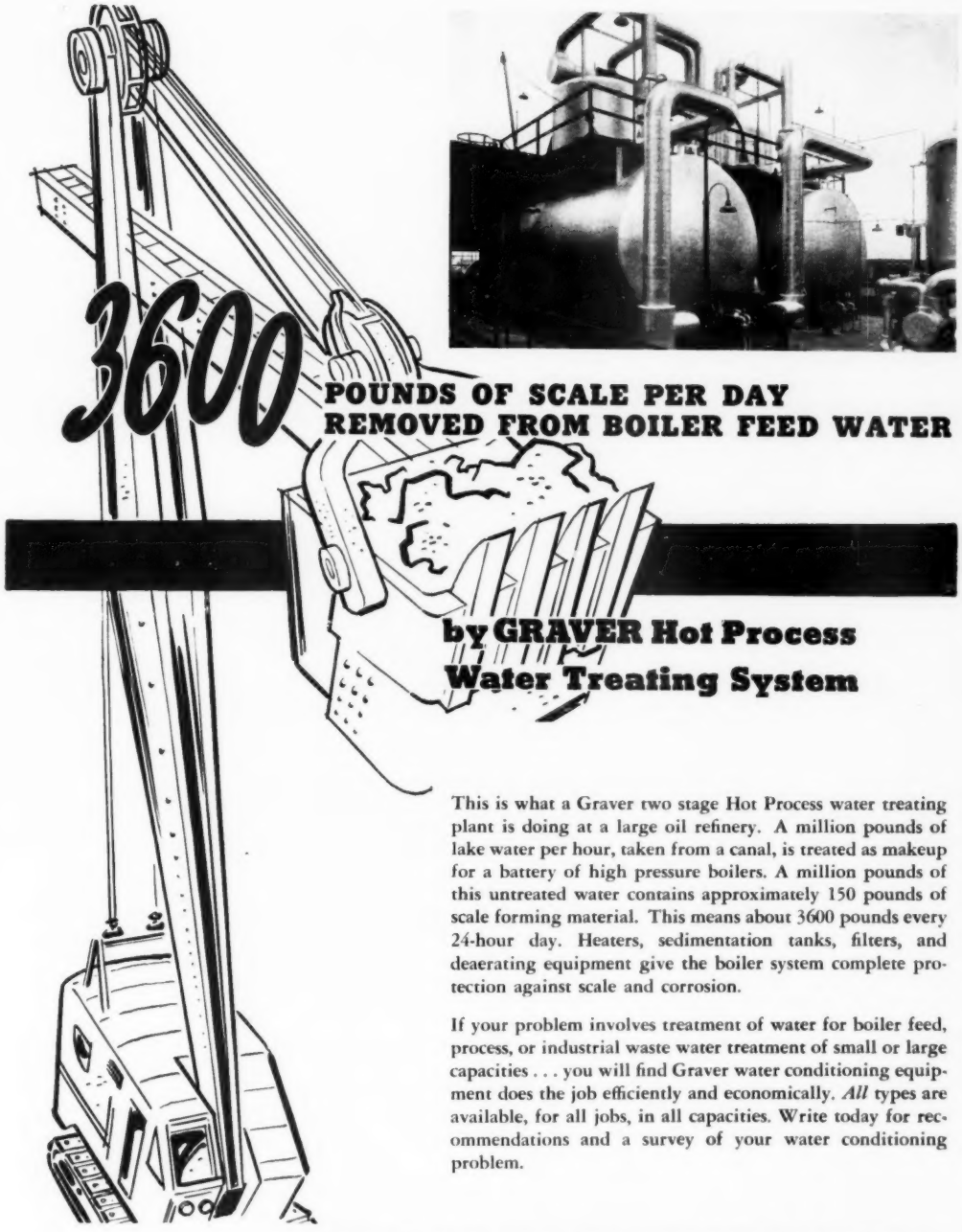

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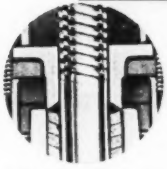

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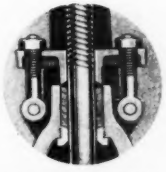

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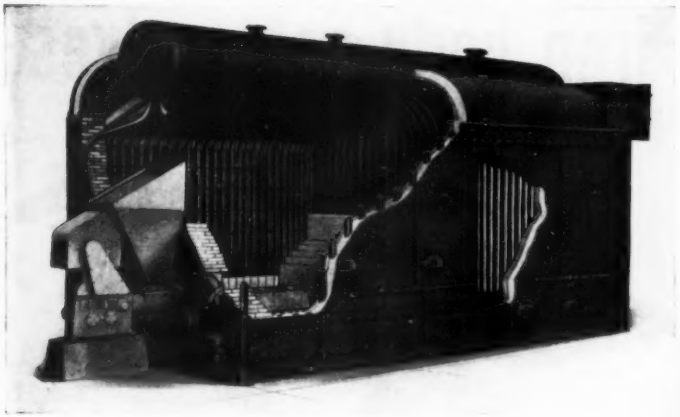

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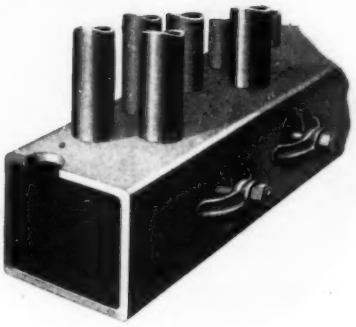
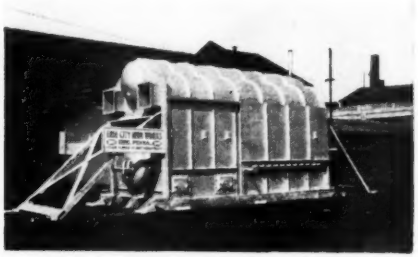


Water Wall tube arrangement—1 Downcomer for each 2 Riser Tubes



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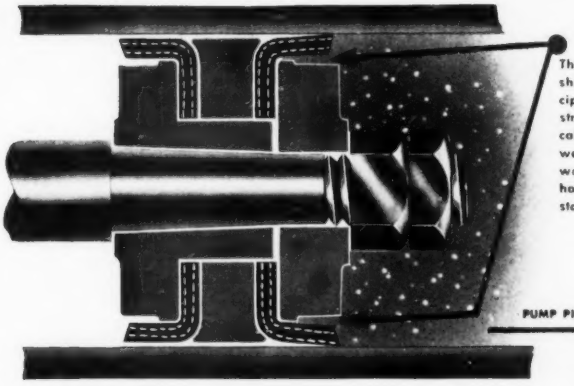

This greatly exaggerated diagram shows the Darcova Pumcup principle. On pressure side of each piston stroke, flexible Pumcup is automatically forced against liner or cylinder wall. Firm, uniform contact all the way around eliminates slippage, holds volumetric efficiency at constant high in spite of gradual wear.

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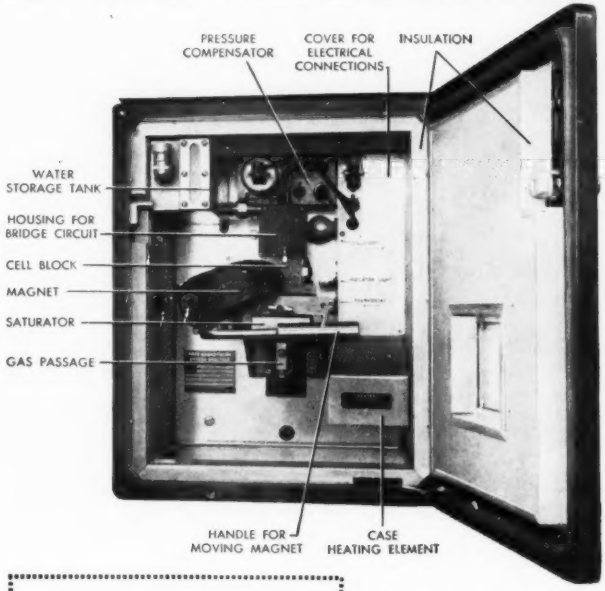

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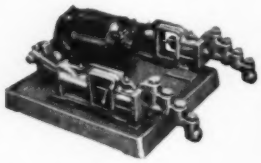

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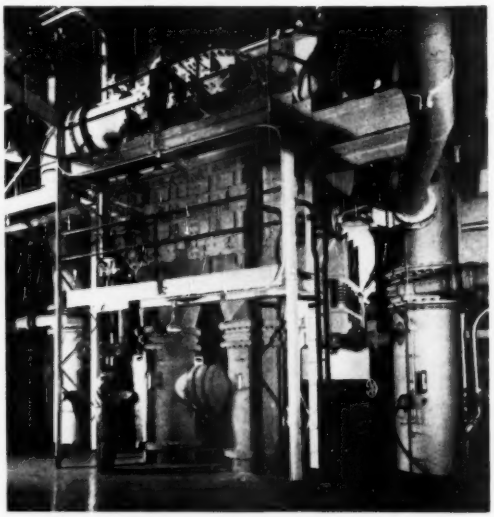

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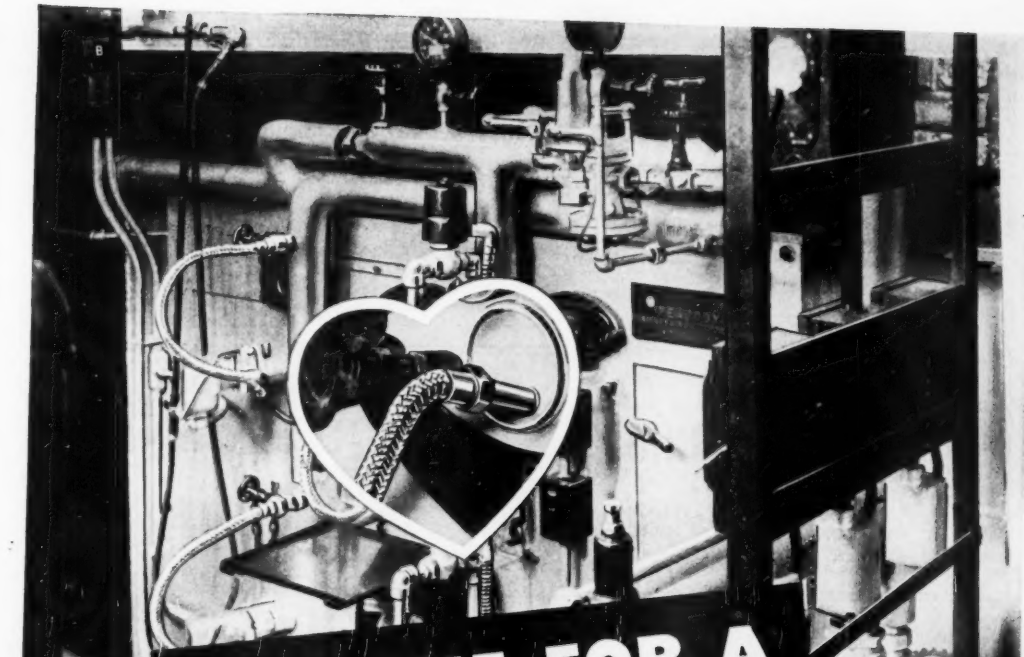

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Some operating engineers say, "Water treatment organizations? They're as alike as peas in a pod!" Other, *more constructive* skeptics wonder, "Am I getting all I should from my present service?"

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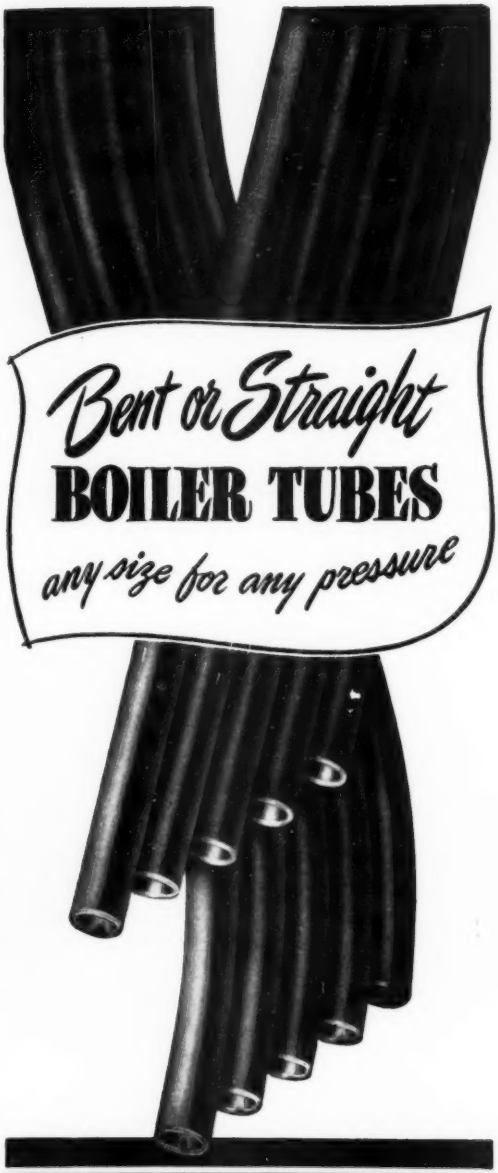

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For Positions of
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Steam Power Plant and/or Gas Plant Experience Preferred—Ideal Community—Close to Metropolitan Areas. Write to
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Well acquainted with many key men in industry throughout western Penna., West Virginia, and eastern Ohio. Impressive sales record covers 14 years in that area. Intimate knowledge steam power plant equipment especially boilers and all types fuel-burning equipment. Satisfactory sales during entire depression. 25 years' total sales and engineering experience.

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One Ames Steam Generator (Oil Burner Type) —70 H.P. 150 lbs., Steam working pressure—complete with all controls—In operation for one year—too small for our plant—*Immediate Delivery.*

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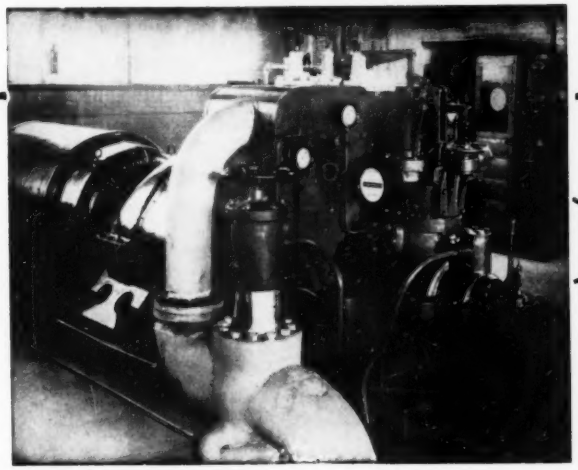

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1500 KW, 250 P.S.I., 150° S.H. 28 inch vacuum direct connected to:

ALTERNATING CURRENT GENERATOR

1875 KVA, 1500 KW, 80% P.F. 3 phase, 60 cycle, 2400 volt 451 Amp. complete and equipped with:

ACCESSORIES

2700 square foot Westinghouse surface condenser, condensing auxiliaries, piping, valves, duplicate exciter sets, switchboard panels and instruments.

EXCELLENT CONDITION

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

8250 KVA G.E. condens., 5 stage, 2300/4000 volts, 200# pressure, 600°TT, 3600 RPM.

5000 KVA G.E., non-cond. Automatic Extraction, 13,800 volts, 600# P.S.I., 750°TT 150# extraction and 25# gauge back.

3125 KVA G.E. condens. 130 P.S.I. 550 volts.

3125 KVA G.E. condensing 175/200 P.S.I. 2300 volt, 500°TT, 3600 RPM complete.

1875 KVA G.E. non-condensing 150# pressure, 30# gauge back, good for maximum 260#, 650°TT, 480 volts, 3600 RPM.

1563 KVA G.E. non-condensing 250 P.S.I. 25# gauge back, 2400 volts, 3600 RPM.

1563 KVA G.E. condensing 250 P.S.I. 2300 volts, 3600 RPM complete.

1560 KVA Allis condens. bleeder, maximum extraction 25,000# per hour, 240 volts.

925 KVA G.E. non-condensing 150 P.S.I. 15# gauge back, 480 volts, 3600 RPM.

625 KVA Westinghouse condensing 150/200# pressure, 2300 volt, 3600 RPM complete.

625 KVA G.E. non-condensing 150# pressure, 15# back, 2300 volts, 3600 RPM complete.

375 KVA (4) G.E. condensing 400# pressure, 2300/4150 volts each complete.

100 KVA Westg. non-condensing 125 to 150 lbs. pressure, 10# gauge back, 2400 volts.

TURBINE-GENERATOR UNITS

Direct Current

400 KW (2) 240 volts direct current Crocker-Wheeler Worthington 440 lbs. condens.

150 KW (2) 3 wire, 250 volts, 225/250 psi, Westinghouse-Worthington condensing.

75 KW Allis-Chalmers-Terry, 125 volts, 2400 RPM, 150 lbs. pressure non-condensing.

60 KW (3) new Westinghouse 120 volt, 200# pressure, condensing.

SYNCHRONOUS MOTORS

3 phase, 60 cycle

5000 KVA Westghse. 4000 volt, 720 RPM *synchronous condenser* complete.

1500 KVA Westg. 2300 volts, 900 RPM synchronous condenser complete.

300 HP 80% P.F. G.E., 2300 volts, 720 RPM.

900 HP Allis. 2200 volts, 150 RPM.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2190 HP, 3 phase, 60 cycle, 4000/6600 volts synchronous motor.

500 KW General Electric 600 volt DC, direct connected to 710 HP, 3 phase, 60 cycle, 2300 volt, 720 RPM synchronous motor.

400 KW General Electric 275 volt DC, direct connected to 710 HP, 3 phase, 60 cycle, 2300 volts, 720 RPM synchronous motor.

300 KW Allis-Chalmers, 250 volt DC generator direct connected to a 430 HP Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1200 RPM synchronous motor.

62½ KVA G.E., 3 phase, 60 cycle, 2300 volt, 1200 RPM alternator direct connected 75 HP, 125 volt DC motor..

ROTARY CONVERTERS

500 KW (2) 6 phase, 60 cycle, 600 volts direct current, 1200 RPM West. sy. converters.

STEAM ENGINE-GENERATOR UNITS

Direct Current

400 KW G.E. 240 volts, 360 RPM generator connected Skinner Unaflow vertical engine, 150 lbs., 10 lbs. gauge back.

275 KW Westinghouse 250 volt, generator connected Ames vertical Unaflow engine.

250 KW (2) G.E. 250 volts generators connected Skinner Unaflow Engines.

200 KW, G.E. 125 volt, 200 RPM generator connected Skinner Unaflow engine.

100 KW Burke 3-wire, 250 volt generator connected Skinner Unaflow engine.

30 KW (2) G.E. 125 volts, 425 RPM generators each direct connected G.E. vertical engine 125 P.S.I.

STEAM ENGINE-GENERATOR UNITS

Alternating Current—3 Phase, 60 Cycle

750 KVA G.E. 2300/480 volt, 150 RPM generator, connected Skinner Horizontal Unaflow non-condensing engine.

625 KVA Westge. 240 volts generator connected Skinner Unaflow Engine.

500 KVA G.E. 2300 volts generator connected Skinner Unaflow Engine.

500 KVA G.E. 240 volt, 360 RPM generator connected Skinner Vert. Unaflow engine.

375 KVA G.E. 2300/440 volts, generator connected 23"x24" Skinner Horizontal Unaflow. Engine 120 P.S.I.

250 KVA G.E. 240 volts, 225 RPM connected Chuse non-releasing engine 150 P.S.I.

175 KVA G.E. 240 volt generator connected Skinner Unaflow Engine.

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900 HP (10) General Motors, Model 12-567 ATL, 12 cylinders, 744 RPM Diesels.

1200 HP (4) Fairbanks-Morse, 8 cylinders, opposed piston, 720 RPM Diesel engines.

OCTOBER BARGAINS

1—New 8400 sq. ft. Ingersoll-Rand Horizontal surface condenser.

4—900 KW, 250/375 volt, 720 RPM Elliott direct current generators direct connected 1200 HP, 8 cylinders Model #38D8⅛ opposed piston, 720 RPM Fairbanks-Morse Diesel Engines.

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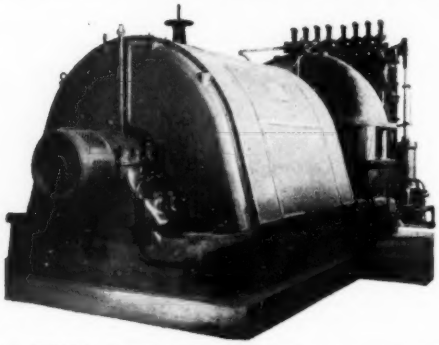
1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

6250-KVA G.E. TURBINE-GENERATOR

Immediate Delivery

A VERY HIGH GRADE MACHINE



Above 6250-KVA., General Electric, Just Purchased, is in A1 Condition. Complete, 200± psig, 2300/4160-v, 3600-RPM., with 7000 sq. ft. Condenser with Auxiliaries. Deliver Duty Free in Canada and the United States.

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CONDENSING

Ref. No.

1—25,000-KVA., West., 300± psi., 600°-FTT 13900 v., 40,000-sq. ft. Condenser.
2— 6,250-KVA., G.E., 200±, 4160/2300-v.
3— 4,375-KVA., G.E., Rebuilt: New Coils.
4— 3,125-KVA., (2) G.E. & West. 250±, 2300-v.
5— 1,875-KVA., (2) G.E. & Allis, 250± 2300-v, Allis 400±, 150-Ext., 480-v.
5½—1875-KVA., Allis. Cond., 2300-v. Rebuilt by U.S. Govt.
6— 2,250-KVA., G.E., 400±, 2300-v.
7— 937-KVA., (2) G.E.-Allis, 480-v. 200±.
8— 625-KVA., (2) G.E.-200±, 480-v., 2300-v.
9—2 NEW G.E., 5714-KVA. 600±-750° FTT Complete: Never Erected.
10—500-KVA., Several: Also 425, 375 KVA.

NON-CONDENSING

11—5000-KVA., G.E., 4000-v, 600±, 150-Extr., 50±-B.P.
12—2500 KVA. (2), West. 300± psi: 25± BP.
13—1825-KVA., G.E., 260±, 480-v., 15/50±-BP.
14—1563 KVA., G.E., 200±, 480-v., 15/25±-BP.
15— 937-KVA., G.E., 200±, 480-v., 15/25±-BP.
16— 625-KVA., West. 300±, G.E., 200± psi, 15/25-BP.

SPECIAL: New, Never Erected 12,500-KVA., G.E., Cond., 15-Stage, 3600-RPM., 630±, 750° FTT. Aut. Extr., 50 or 60 Cycle, 13,800-v. A COMPLETE NEW INSTALLATION.

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OUR SPECIALTIES: Turbine-Generators, New and Used, Diesel Power, Boilers—Anything and Everything for POWER PLANT USE.

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DIESEL POWER: 4—1600-HP., F-M. O.P., 1250-KVA. NEW Generator Sets: 4—1200 O.P. F-M., with 900 KW. Elliott, 720-RPM. Generators: 12—300 KW Baldwin-Westinghouse DC. Sets: 3—100 KW Westinghouse AC Gen. and Many Others. Please send specifications if not listed.

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40th Year

1 YEAR GUARANTEE

RELIABLY REBUILT—DEPENDABLE EQUIPMENT

PARTIAL LISTINGS ONLY

Squirrel Cage Motors

H.P.	Make	Type	Speed
450	G.E. vert.	KF-6338	1180
250	L.A.	OGS-1378	1200
250	G.E.	K-568	575
200	G.E.	KF-6335Z	880
147	West.	25 cy.	1750
125	Al. Ch.	AR-630F	450
100	G.E (2)	K-544	1175
100	West.	CS	870
100	G.E.	KT-556	865
100	West. (2)	CS	690
75	West.	CS-505S	1760
75	West.	CS-662-C	1150
75	G.E. (3)	KT-352	870
75	G.E.	KT-356	690
75	West.	CS	670
60	West.	504-S	1750
60	Rel.	AA-C5084Z	870
60	West. (2)		900
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	G.E.	K-445	1170
50	West.	CS	800
40	G.E.	KT-336	900
40	West.	CS	900

Partial List Only!

Slipring Motors

H.P.	Make	Type	Speed
600	C. Wh.		514
200	G.E.	MTP	1800
200	G.E.	IM	1200
180	G.E.	MT-564Y	580
100	G.E.	IM	1800
100	Al. Ch.		690
75	G.E.	IM	870
75	G.E.	IM	690
60	Al. Ch.		690
60	G.E.	M-6326TEFC	855
50	West.	CW-554	1155
50	Al. Ch.	ARY	575
50	F-M	BV	575
50	G.E.	IM	490
40	G.E.	IM	1200

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
400	G.E. (4)	TS-982S	600
260	G.E.	TS	900
200	Ideal (2)		257
180	G.E.	ATI	900
150	G.E.	ATI	720
150	G.E.	TS	1200
125	West.	G	1200
100	Elec. Prods.		1200

A.C. GENERATORS

K.W.	Make	Type	Speed
288	West.	G	900
187	West. (2)	G	514
75	G.E.	ATB	360
75	G.E.	ATB	1200

D.C. to A.C. Generators

K.W.	Make	D.C.	A.C.
25	G.E.	230	220
25	Star	115	120
25	Ideal	115	440
25	El. Mchy.	230	440
7½	Hertner	115	440
5	El. Spec.	110	110

550 V. D.C. Motors

H.P.	Make	Type	Speed
765	G.E. (6)	MPC	1045/1350

230 V. D.C.
Variable Speed Motors

H.P.	Make	Type	Speed
100	Rel.	1050-T	400/1200

230 V. D.C.
Variable Speed Motors
(Continued)

H.P.	Make	Type	Speed
75	G.E.	D	500/1500
75	Cr. Wh.	CMC-125H	375/750
60	G.E.	C	480/1100
55	Cr. Wh.	CCM-125H	165/800
50	West.	SK	250/1000
50	West.	SK	500/1500
50	G.E.	RF-17	475/950
40	Rel.	461T	400/1200
40	G.E.	CD-1441	400/1500
25	West.	SA	500/1800
25	Rel.	185-T	500/1500
25	G.E.	RF-13	400/1600
25	G.E.	RF-14	400/1200
25	G.E.	RF-14	300/1200
20	G.E. (6)	RF-12	400/1200
20	West.	SK	375/1500
15/20	Rel. (4)	185-T	400/1600
15	West. (4)	SK-95	600/1500
15	E.D.		500/1500
15	West.	SK-12	350/1000
15	West.	SK	250/1000
15	West.	SK	500/1500
10	G.E.	RF-10	600/1800
10	G.E.	CD-83	600/1800
10	West.	SK	600/1200
10	West. (3)	SK	500/1800
10	G.E.	RF	400/1600
10	G.E. (3)	RF	400/1200
10	Rel.	131-T	250/1000
7½	West.	SK-70	500/1500
7½	G.E.	RF-10A	450/1600
7½	Al. Ch.		350/1050
5	West. (3)	SK-60	500/1500
5	G.E.	RF-9	450/1800
5	G.E.	RF	450/1800
5	Rel. (2)	46-T	400/1600

230 V. D.C. Motors

H.P.	Make	Type	Speed
150	G.E.	RC-19	800
125	G.E.	RC-15	1750
100	G.E.	RC-14	1750
100	Al. Ch.		1200
75	West.	SK-170	635
75	West. (2)	SK-180	475
75	Cr. Wh.	53-HM	480
60	West. (2)	S-160	680
50	G.E.	RC-12	1750
50	West.	SK-133	1300
50	Diehl	K-10	850
50	West.	SK	750
50	West. (2)	SK-160	585
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC	1750
40	G.E.	RC-32	1100
40	G.E.	RC-13	1075
30	G.E. (2)	RC	1200
30	West. (2)		975
30	G.E. (2)	RC-33	775
30	West. (2)	SK-143	575
20	G.E. (2)	CD-83	1750
20	G.E. (2)	RC-11	1150
20	Star (2)	SR-816	29.3

115 V. D.C. Motors

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr. Wh.	CMC	900
25	G.E. (2)	CD	1800
25	Cr. Wh.	CCM	750
20	Century	RS	1750
20	G.E. (2)	CD-83	1750
20	West.	SK-110L	750
12½	G.E.	CDM-85	930/1160

600 V. GENERATORS

KW	Make	Speed
200	Cr. Wh.	900
30	Burke	1750
30	E.D.	1150
20	G.E.	1750

250 V. GENERATORS

KW	Make	Speed
1000	G.E.	900
500	West.	1100
330	Elliot	1200
300	G.E.	1200
300	Al. Ch.	1200
300	West.	900
300	West.	1200
200	G.E. MPC	1200
150	West.	900
150	West.	1180
150	G.E.	600
100	Hertner	1200
75	G.E.	1750
50	G.E.	1200
40	Reliance (4)	1750
30 (3)	G.E.	1750
30	Cont.	1200
25	G.E.	1200
15	G.E.	1750
10	Star	1750
7½	West.	1200
5	West.	1750

125 V. Generators

KW	Make	Speed
250	G.E.	720
150	Cr. Wh.	1200
150	West.	1150
100 (2)	West.	900
100	G.E.	1200
100	El. Machry.	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	Sturt.	2800
40	Cent.	1450
30	Ideal (2)	1750
30	G.E.	1150
30	L.A.	1450
25 (2)	El. Mchy.	1150
20	Deleo	1200
15	G.E.	1150
10	Rogers	1450
7½	West.	1200
5	G.E.	1750

Low Voltage Generators

Amp.	Make	Voltage
8000	H-V-W.	6/12
5000	Optimus	6/12
1800	H-V-W.	6/12
1000	Col.	6/12
125	Hobart (8)	7½
300	Star	15
67	Cont.	15
750	Star	15
1000	G.E.	15
800	G.E.	22/23
600	Rel.	24
134	West.	24
175	Cr. Wh.	25
550	Col.	27
1600	G.E.	30
800	G.E.	30
100	G.E.	30
200	West.	30

Low Voltage Gen. (Cont.)

Amp.	Make	Voltage
205	G.E.	32
1000	G.E.	33
500	Chandeyssen (2)	40
1000	Chandeyssen (2)	40
205	G.E.	42
24	G.E.	44/54
75	G.E.	50/10
800	G.E.	50

Transformers

4—333 KVA Maloney 2300/4600 Primary 220/440 Secondary

300 KVA—Al. Ch. 3 phase, 4160 V. primary, 230 V. secondary.

300 KVA—Pittsburgh, 3 phase 4160 V. primary, 230 V. secondary.

50 KVA—(2) G.E.-H-KP 2400/4160 Y-122/40 V.

New D.C. Starters

150—230 V. Magnetic 5 H.P. to 75, H.P. G.E., C-H, A-B, W.L. etc.

100—230 V. Manual and Compound 1 H.P. to 5 H.P.—G.E. & C-H.

40—7½ H.P. 230 V. C-H—magnetic reversing.

A.C. Starters

1—475 H.P. West. Magnetic Reduced voltage, 550 V. syn.

4—400 H.O. C-H Bul. 9976 440 volt. Magnetic red. volt. synchronous.

1—250 H.P. C-H. 4150 V. synch. full voltage.

1—150/200 H.P. G.E.—440 V. CR-7065 synch.

3—150 H.P. GE 220V-CR 7061 synch.

2—150 H.P. West. Class 11400-440-V Auto. Resistance.

New A.C. Starters

40—C-H & A-B 2 and 4 speed Magnetic up to 25 H.P.

20—50 H.P. C-H 440 V. Magnetic.

165—20 H.P. W.L. 440 V. Magnetic.

635—7½ H.P. C-H 440 V. Magnetic.

Air Compressors

425 Cfm. Sullivan 2 stage.

360 Cfm. American 125 lbs.

Electric and Air Hoists

17—2 ton Shepard-Niles, 230 V. D.C.

8—500 lbs. P. & H. Zip Lift, 3 phase.

1—2 ton Thor, pneumatic.

1—½ ton, Thor, pneumatic.

400 Cy. Gen.

1—3 KW G.E., 3 ph. 110 volt.

1—7½ KW G.E. 3ph. 400 cy.

1—10 KW G.E., 200/700 cycle.

1—15 KW G.E. 3ph. 400 cy.

EST. 1910 — L. J. LAND INC. — 40th YEAR

156 GRAND STREET — Phone CAnal 6-6976 — **NEW YORK 13, N. Y.**

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WAGNER

Quality and Service

"CERTIFIED REBUILT"

DEPENDABLE ELECTRICAL EQUIPMENT AT LOW COST

MOTORS . . . GENERATORS . . . M-G SETS

PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL STOCK LISTING—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

250 KW Allis-Chalmers M-G Set, DC 120/240V. output, 363 H.P. Synch. Motor, 3/60/440V. 1200 RPM, AC & DC panels, late model, imm. shipment.

M-G SETS

KW	Mfr.	Input V	Output V
450	Gen. Elec.*	2300 AC	275 DC
300	Allis Ch.*	220/440 AC	250 DC
250	Allis Ch.*	440 AC	120-240 DC
200	Ridgeway*	2300/4000 AC	550 DC
200	Gen. Elec.	220/440 AC	125/250 DC
150	Cr. Wheeler*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Gen. Elec.*	220/440 AC	250 DC
100	Gen. Elec.*	220/440 AC	125 DC
75	Cr. Wheeler b.b.	220-440 AC	250 DC
75	Gen. Elec. (2)	220/440 AC	125 DC
50	Gen. Elec.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
40	Gen. Elec.	220/440 AC	120 cycle
40	Northw'n Conv.	220 AC	230 DC
37½	Whse.	230 DC	240/480 AC
35	Gen. Elec.	220/440 AC	45 DC
30	Gen. Elec.	220/440 AC	250 DC
30	Elec. Prod.*	220/440 AC	80 DC
20	Whse.	220/440 AC	250 DC
15	Gen. Elec.	220/440 AC	125 DC

*Synch. motor drive.

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	230	800
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
75	G.E. New b.b.	CDM	230	1755
75	Cr. W. New b.b.	CMC	230	1150
75	Allis Ch.	E	230	800
75	Whse.	S13L	115	570
75	Gen. Elec.	BRC	115	1150
75	Northw'n	K20	230	1750
60	Gen. Elec.	RC36	230	650
50	Elec. Dyn.	25-S	230	450/900
50	Allis Ch.	E131	230	850
50	Gen. Elec.	RC34	230	1100
40/60	Whse. (2)	SK170	230	500/1000
40	Sprague dyna.	LC	230	750/2000
40	Gen. Elec.	RC32	230	1150
40	Gen. Elec.	CD113	230	850
35/50	Gen. Elec.	CD123	230	575/1150
35	Ideal	DV350	230	400/1200
30	Whse. (2)	SK93	230	1750
30	Whse.	S-7	115	900
30	Gen. Elec.	RC31B	230	1150
25	Sprague dyna.	LC	230	750/3000
25	Chandson (4)	C13	115	850
25	Gen. Elec.	CD85	230	1750
20	Gen. Elec.	RF12	230	400/1600
20	Whse.	SK93	230	1150
20	Reliance	T	230	850
20	Gen. Elec.	CD85	230	1150
20	Whse.	SK130	230	500/1800
15	Whse. (3)	SK90	230	825
15	El. Dyn. b.b.	326	230	1750
15	El. Dyn. b.b.	15S	230	300/1200
15	Whse. (2)	SK80L	230	1150

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	250	1200
105	Century b.b.	1500 amp.	70	1300
100	Gen. Elec.	RC17	125	1200
100	Gen. Elec.	C	250	750
75	Allis Ch.	E	250	750
75	Whse.	S	125	600
75	Cr. Wheeler b.b.	CCD	250	1450
75	Gen. Elec. (2)	RC36	125	1200
50	Gen. Elec.	RC34	250	650
50	Gen. Elec.	RC	250	1250
40	Gen. Elec.	RC32	250	1450
30	Elec. Prod.	BP	50	1150
30	Gen. Elec.	RC	250	1500
20	Reliance	T	250	1150

EXPLOSION PROOF MOTORS

from 1 to 20 H.P..... std. speeds

A. C. MOTORS—25 CYCLE

H.P.	Mfr.	Type	Volts	Speed
150	Whse.	HF	440	500
150	Gen. Elec.	IK-16	440	750
50	Allis Ch.	ANY	440	750
50	G.E. int.	MTC5337	440	750
50	G.E.	I-K	440	750
50	Gen. Elec.	KT339	440	1500
40	Gen. Elec.	KT343	440	750
20	Gen. Elec.	KT327	440	750
15	Whse. TEFC	CS365	220/440	1500

A. C. GENERATORS—60 CYCLE

KVA	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
300	Gen. Elec.	ATB	240/480	720
250	Whse.	G	2300	600
200	Gen. Elec.	ATB	240/480	600
187	Gen. Elec.	ATB	240/480	900
150	Gen. Elec.	ATB	2300	450
150	Gen. Elec.	ATB	240/480	900
125	Gen. Elec.	ATB	240/480	300
100	Gen. Elec.	ATB	240/480	900
100	Gen. Elec.	ATB	240/480	1200
75	Gen. Elec. New b.b.	ATI7552	240/480	1200
50	Gen. Elec.(2)	ATB	240/480	1200
50	Gen. Elec.	ATB	240/480	900
31	Gen. Elec.	AT17536	240/480	1200
25	Whse. b.b.	1 ph.	120/240	900

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	500	Allis Ch.	ANY	450
1—	350	G. E. 2200 V.	I-M	360
2—	300	Allis Ch. 2200 V.	ANY	720
1—	300	G.E. 2300 V.	I-M	1800
1—	300	Whse. 2300 V.	CW	600
1—	250	Whse. b.b.	CW32B	900
1—	200	Gen. Elec.	I-M-17	600
1—	200	Gen. Elec.	IM-17A	450
1—	150	Whse.	MW	450
1—	150	G.E. 2200/4000 V.	I-M	1200
1—	150	Allis Ch.	ANY	600
1—	100	Allis Ch.	ANY	1800
1—	100	Al. Ch. b.b. NEW	ARY	600
1—	100	Allis Ch.	ANY	720
1—	100	Whse. int. 2200 V.	C1656C	600
1—	100	Whse. int.	CI-786A	720
1—	100	Fair. Morse b.b.	HV	900
1—	75	Gen. Elec.	I-M-E13	1200
2—	75	Gen. Elec.	IM-14	720
1—	75	G.E. int. duty	MTC5342	900
1—	75	Ideal int.	AVE	1200
1—	75	Gen. Elec.	MT558	600
2—	75	Gen. Elec.	IN-14	600
1—	75	Gen. Elec.	MT337	1800
1—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Fair. Morse	BV	720
1—	50	Gen. Elec. int.	ITC	600
1—	50	Whse. int.	CI	600
1—	50	Gen. Elec.	I-M	720
1—	40	Gen. Elec.	MT336	900
1—	37	G.E. int.	ITC	600
2—	30	Gen. Elec.	MT526	1200
1—	30	Gen. Elec.	OMT336	1200
1—	30	Gen. Elec.	MT346	600
2—	25	Gen. Elec.	MT332	900
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
1—	20	Gen. Elec	MT503	1800
1—	20	Gen. Elec.	MT336	900
12—	10	Reliance New b.b.	AW-394	1800

A. C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
300	Gen. Elec.	AT1	220/440	720
300	Whse.	G	2200/440	600
250	Ideal	2BC-M4	2200	450
220	G.E. 3 brg. .8 PF	AT1	220/440	600
200	G.E. .8 PF	AT1	220/440	900
150	Gen. Elec. .8 PF	AT1	2300	450
150	Gen. Elec.	AT1	220/440	300
125	G.E. splprf. .8 PF	TS955	220/440	1200
125	Gen. Elec.	AT1	220/440	900

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	400	Whse. 2200V.	CS	1800
1—	300	Gen. Elec.	KT563	1200
1—	250	Whse.	CS	900
1—	200	Reliance b.b. NEW	C5085	1800
1—	200	Allis Ch.	AN	1200
1—	150	Gen. Elec.	I-K-16	600
1—	150	Whse. 2200 V.	CS771-1C	1800
1—	150	Reliance b.b. NEW	B6085	1200
1—	150	Gen. Elec.	IK-15	900
1—	125	Reliance b.b. NEW	C5085	1200
2—	125	Allis Ch. 2200 V.	AN	1200
1—	125	Gen. Elec.	IK-16	450
1—	125	Cont. 2200 V. b.b.	SC	1800
1—	125	Gen. Elec.	KT339	3600
2—	125	Rel. TEFC NEW	B6085	1800
1—	100	Gen. Elec.	I-K	1800
5—	100	Allis Ch. 2200 V.	AR226	1200
1—	100	Reliance b.b. NEW	C5085	900
1—	100	Elec. Machy.	b.b.	1200
1—	100	Rel. TEFC NEW	C5085	1800
1—	100	G.E. b.b. NEW	K504S	1800
1—	100	Cont. TEFC	NP682	1200
1—	100	Gen. Elec.	IK-15	720
2—	75	Gen. Elec.	IK	600
1—	75	Gen. Elec.	I-K 14	720
1—	75	Reliance b.b. NEW	C5084	900
1—	75	Gen. Elec.	KT552	900
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT329Y	3600
1—	75	Reliance b.b. NEW	C505	1200
1—	75	Gen. Elec.	KT347	1200
1—	60	Gen. Elec.	KT552	720
1—	60	Gen. Elec.	KT340	900
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Rel. TEFC NEW	C505	1200
2—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse. H.T.	CS804	1800
1—	60	Wagner b.b.	R7444	3600
1—	50	Whse. b.b. NEW	CS405S	1800
1—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Gen. Elec.	KT336	1200
1—	50	Gen. Elec.	KT342	900
1—	50	Whse. hidip	WL607	900
2—	50	Whse. b.b.	CS804	1200
2—	50	Gen. Elec.	KT352	600
1—	40	Gen. Elec. b.b.	KF404S	3600
2—	40	Gen. Elec.	KT527	1800
1—	40	Al. Ch. 3 speed	ARX 900/600/450	
4—	40	Gen. Elec.	KT338	900
2—	40	Reliance b.b. NEW	C404	1800
2—	40	Rel. TEFC NEW	C445	1200
3—	40	G.E.	KT532	1200
2—	35	Gen. Elec.	I-K	720
2—	30	Howell b.b. speed	SC	1800
1—	30	G.E. NEW b.b.	K365	1800
3—	30	G.E. NEW hidrep	KG365	1800
3—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec.	I-K	900
1—	30	Gen. Elec.	KT336	720
1—	30	Wagner	22T8P	900
1—	30	Whse.	CS646	900
2—	30	Reliance b.b. NEW	C405	1200
2—	30	Reliance TEFC NEW	C445	1200
1—	30	Cr. Wheeler b.b.	SC30Y	1800
2—	25	Gen. Elec.	KT326	1200
2—	25	Rel. TEFC NEW	C444	900
3—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
3—	25	Whse.	CS646	900
3—	25	Gen. Elec.	I-K	600
1—	20	Reliance b.b. NEW	C404	900
1—	20	G.E. TEFC b.b.	K404	1200
4—	20	Reliance b.b. NEW	C364	1800
3—	20	L.A. NEW exp. prf.	EK364	1800
3—	20	Whse. NEW b.b. spl.	CS364	1800
2—	20	Gen. Elec.	KT312	1200
1—	20	Whse.	C8	1200
2—	20	G.E. NEW b.b.	K365	1200

ARTHUR WAGNER COMPANY

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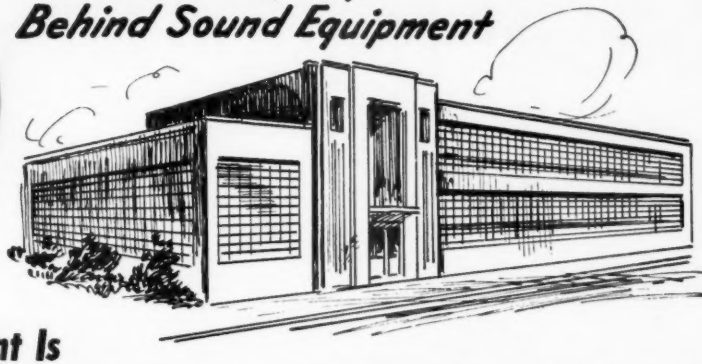
A Sound Company Behind Sound Equipment



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NO ITEM OF HEMPHILL REBUILT EQUIPMENT IS SHIPPED TO THE BUYER UNTIL TESTS PROVE THAT IT WILL GIVE YOU PERFECT SERVICE

TRANSFORMERS

1—1000 KVA G.E., 3 Ph. auto 4150V.—2300V.
1— 500 KVA Kuhlman 4150 V Pri. 2300 V. Sec.
3— 400 KVA G.E., 6900 Primary—2300 Secondary
3— 300 KVA Pitts., 2300 V. Prl., 115/230 V. Sec.
3— 300 KVA, G.E., type H, 2300 V Prl., 115/230 V. Sec.
300 KVA, Pitts., 7800-440 v.
205 KVA, Whse., 2 ph., 2300 to 3 ph., 4150 auto.
200 KVA, 4000 v.—110/220
100 KVA, Pitts., 1375/2750 v. — 110/220.
3— 100 KVA G.E. 4150 volt 230/460 volt Pyranol
3— 100 KVA, Wagners, 240/120 v.—120 v.
2— 100 KVA, Newark, 440 v., 3 ph. to 220 V., 2 ph.
2— 100 KVA, Whse., 13800 v. to 250 v.
3— 75 KVA, G.E., 2400 v.—120/240
6— 50 KVA, Whse., 2400 v.—120/240 Inerteen
6— 50 KVA Whse., 13,800 v. to 125 v. or 250 v.
6— 50 KVA, Whse., 6900 v. to 125 v. or 250 v.

A. C. GENERATORS

2500 KVA, Whse., Syn. Cond., 720 RPM, 2400 v.
500 KW, .8 P.F., 3600 RPM, ATB, 600 v.
320 KW, Allis, 450 RPM, 480 v.
240 KW, G.E., ATB, 600 RPM, 600 v.
200 KVA, Allis, 3600 RPM, 240 volt
200 KVA, Whse., 600 RPM, 240 v.
180 KW, Whse., 514 RPM, 550 v.
100 KW, G.E. ATB, 600 RPM, 240 v.
75 KW, Whse., 900 RPM, 220 v.
62½ KW, Allis, 3600 RPM, 220 v.
7— 50 KVA, Whse., 900 RPM, 220 v.
3— 35 KWA, Columbia, 1200 RPM, 240 v.
1— 31.3 KVA, America, 1200 RPM, 120/208.
15 KW, Star, 1800 RPM, 220/440.
12.5 KVA, Whse., 1200 RPM, 240 v.

TURBINE BLOWERS

1—Spencer, 1000 cubic feet, 36 oz. pressure with a 15 H.P., 3600 RPM, General Electric Type FT 200 volt motor.
1—Bellmore, 550 cubic feet, 7 inch vacuum, with a 20 H.P. 3600 RPM, General Electric, Type K, 220 volt 3 phase motor.

MOTORS, 3 Phase, 60 Cycles SQUIRREL CAGE

450 H.P., Ridgeway, 900 RPM, 2200 volts.
125 H.P., G.E., KF, 1750 RPM, 2200 v.
125 H.P., U.S., 1200 RPM, Vert., 220 volts.
100 H.P., G.E., 400 RPM, 440 volt.
75 H.P., West., CS, 1750 RPM, 440 volts.
60 H.P., Whse., 900 RPM, Vert., 220 volts.
60 H.P., Whse., 900 RPM, 440 volts.
2— 40 H.P., G.E., 900 RPM, 220 volts.
40/20 H.P., Westinghouse 600/450 440 volt.
35 H.P., Whse., 1200 RPM, CS, 2200 volts.

MOTORS, 3 Phase, 60 Cycles SLIP RING

2500 H.P., G.E., 257 RPM, 6600 volts.
450 H.P., G.E., 425 RPM, ITC, 440 volts, 25 cycle.
2— 150 H.P. G.E., 1M, 440 volt, 450 RPM.
100 H.P., G.E., 1M, 440 volt, 25 cycle, 720 RPM.
1— 100 H.P. G.E., 1M, 440 V. 400 RPM.
75 H.P., Whse., CW, 720 RPM, 440 volt.
75 H.P., G.E., MT, 1200 RPM, Vert.
50 H.P., G.E., MT, 600 RPM, 220 volt.
2— 50 H.P., Whse., CW, 900 RPM, 220 volts.
40 H.P. Cont., 1200 RPM, JA85 220 volt.

AIR COMPRESSOR

312 CFM, I-R Model 75, 2 stage, 900 RPM, 100# with 75 H.P. Squirrel Cage Mtr.

DIESEL GENERATOR SETS

1—300 KW 125/250 V. De La Vergne Baldwin 6 cyl. 4 cycle with Westinghouse generators

LARGE STOCK OF D. C. MOTORS AND GENERATORS SYNCHRONOUS MOTORS

4—200/100 H.P., Whse., 720/360 RPM, 4150 v.
200 H.P., Whse., 600 RPM, 240 v.
1—200 H.P., G.E., 257 RPM, 440 volt.
1—150 H.P., G.E., 1800 RPM, 220 v. TS
2—150 HP., A.C. 360 RPM, 2200 V.
100 H.P., G.E., TS 900 RPM, 2200 V
75 H.P., G.E., 1200 RPM, 440 v.
70 H.P., Elevt. Mach., 180 RPM, 2200 v.
40 H.P., Whse., 1800 RPM, 220 v.
35 H.P., G.E., 1200 RPM, 2200 v.
20 H.P., Whse., 1800 RPM, 220 v.

MOTOR GEN. SETS

1—1000 KW, Whse., 275 V.—4150—720 RPM, Syn.
1—1000 KW, G.E., 600 volts—4150—514 rpm. Syn.
1— 400 KW, G.E., 250 V. 900 RPM, 2300 V. Syn.
1— 500 KW., G.E., 575 V, 900 RPM, 2300 V. Syn.
125 KW., CW, 125 v., 1200 RPM, 2300 v. sq. cage.
100 KW, El. Mach., 125 v., 1200 RPM, 4150 v. syn.
100 KW, G.E., 230 v., 900 RPM 4150 v. Syn.
2— 75 KW., G.E., 125 v., 1200 RPM, 220/440 v.
8— 75 KW., G.E., 60 v., 1200 RPM, 220/440 v.
50 KW., Ridgeway, 550 v., 1200 RPM, 220 v.
25 KW., G.E., ATI, 1800 RPM, 40 HP, 1800 RPM, 230 v.

PLATING M.G. SETS

250 Amp. G.E., 5/6 volt, 220 v.
500 Amp., Hansen Van Winkle, 24 volt, 220/440 v.
2500 Amp., Chandeysson, 6/12 v., 400 RPM, Syn., 440 v.
3000 Amp., Chandeysson, 6/12, 400 RPM, syn., 440 v.

ENGINE GEN. SETS

150 KVA, G.E., Amoa Uniflow, 220 v., 3 ph., non cond.
2— 5 KW, Gasoline, Hobart, 1800 RPM, 120 v., 1 ph. cont. engines.
1—200/275 H.P., Gasoline Engine, Van Blerck, 8 cylinder, 1500/900 rpm.

TURBO GEN. SETS

625 KVA, Whse. 2400 v., 3 phase, non-con.
300 KW, G.E., ATB, 240 v., 3 ph. cond.
60 KW, Whse., 120 v., D.C., cond.

STEAM TURBINES

500 HP., G.E., 3 stage, 165#, 3240 RPM.
800 HP., Terry Tandem type, 720 RPM, red. gear

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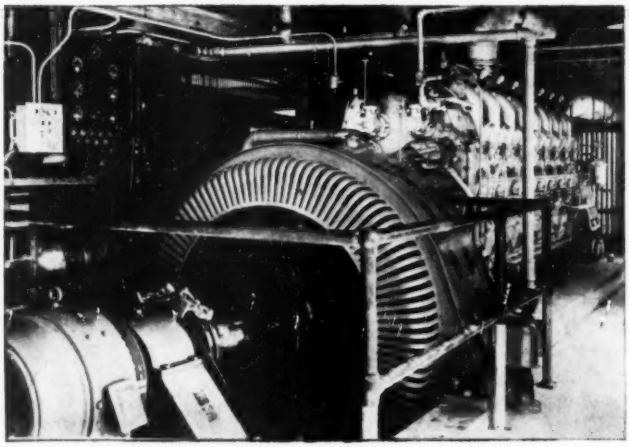
Another AGSCO INSTALLATION



Engineered and installed by A. G. SCHOONMAKER COMPANY, INC. for the Southern Utah Power Company, this 1250 KVA, 1000 KW GMC Diesel Unit is in continuous service at their Cedar City, Utah power plant. Write today and learn what "AGSCO ENGINEERED DIESEL POWER" can do for your plant.

INVENTORY AVAILABLE FOR IMMEDIATE SHIPMENT

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33F16	2000	300	312	General Motors	8-268A	450	1200
1420	Fairbanks Morse	38D	1600	720	300	Fairbanks Morse	YVA	360	257
1250	General Motors	16-278A	1600	720	250	General Motors	8-268A	350	1200
1250	Nelseco	6M1-53	1500	300	200	Buckeye	80	240	600
1000	General Motors	12-278A	1200	720	187	Ingersoll Rand	S	225	514
937.5	General Motors	12-567	1080	720	125	General Motors	3-268A	150	1200
625	Alco	6-12-½x13T	750	600	121	Fairbanks Morse	32E14	140	300
625	Baldwin	VO-8	750	514	75	General Motors	6043C	90	1200
625	Superior	OS	750	327	75	Fairbanks Morse	35E8-¾	90	450
425	Baldwin	VO-6	510	450	62	Int'l Harvester	UD-18	76	1200
400	Buckeye	80	480	600	50	General Motors	4-71	60	1200
375	Enterprise	DSG-6	450	450	25	Hill	4R	31	1200

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A. G. SCHOONMAKER Company, Inc.

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52 CHURCH STREET, NEW YORK 7, N. Y. PHONE DIgby 9-4350

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RE NU BILT — BELYEA — MOTORS

SUCCESSFUL OPERATION GUARANTEED

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2200/4400
1	1250	G.E.	600	275	2300
1	1000	Whse	900	600	2300/4150
1	1000	Whse	720	600	2300/4150
1	1000	West.	514	250	4150
1	1000	Whse.	514	600	4150
1	800	G.E.(3U)	1200	120/240	2300
1	750	Whse	900	250	2300
1	500	G.E.	720	600	2300/4150
1	500	G.E.	720	125	2300/4000
2	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	2300/4150
1	300	G.E.	1200	250	440
1	150	G.E.	1200	250	550
1	150	Cr. Wh.	1200	250	440
1	140(3U)	Cr. Wh.	690	125/250	2300
1	100	G.E.	1170	125	220
1	75	Cr. Wh.	1170	250	220/440
1	75	Cr. Wh.	1200	250	550

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4800	720

ROTARY CONVERTERS

60 Cycle

	Make	Speed	D.C. Volts	A.C. Volts
1—2000	G.E.	514	600	13800
1—2000	G.E.	450	600	2300
1—1000	Whse.	900	600	11000
1—750	Whse.	900	600	13200
1—500	Whse.	900	250	2300

FREQUENCY CHANGER SETS

1—1000 KW—Al. Ch. Consisting of 1400 HP, 2300 V. 3 ph. 25 cy. Motor and 1000 K, 2300 V. 3 ph. 62½ cy. gen. switch exciter.

1—1000 KW—GE—2 unit—3 Brg. Consisting of 1400 HP—4400 V., 3 ph. 25 cy. Motor and 1000 KW—2300 V. 2 ph. 58.3 cycle gen. with exciter (Gen. can be reconnected for 800 KW 3 ph.)

1—320 KW-GE—2 Unit—3 Brg. consisting of 600 HP—440 V., 3 ph. 60 cy., 8 pf. Syn. Motor and 400 KVA, 8 pf, type AT—3 ph., 120 cy, 720 volt AC generator with direct connected exciter.

SPECIAL—MERCURY ARC RECTIFIERS

1—750 KW—GE—Type RHW—6 Anode 575 V., D.C. Form C with 2300 V., 60 cycle transformer and switching equipment.

1—1000 KW—American B.B. Type GRZ-612—12 anode 625 V.D.C. with 1040 KVA O15C—3 phase—13200/6600V-25 60 cycle transformer with full automatic switching equipment along with 2 distribution panels.

1—1000 KW—Al.Ch. type B-612—12 anode 625 V.D.C. with 1140 KVA O15C—3 phase—13500V.—60 cycle transformer with manually operated switching equipment along with voltage regulator and grid control.

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1750	Whse.		600	525/720
2—1500	Whse.		525	600
1—1200	Whse.		600	425
1—800/1000	Whse.		450	600/720
1—700	G.E.	MCF	600	150/525
1—650	G.E.	MPC	230	115/145
1—600	Al. Ch	MILL	230	400/800
1—300/400	G.E.	DYNA	250	1325/2500
1—535	Whse.	MQ	250	300/900
1—200/300	G.E.	MPC	230	360/920
1—275	Whse.	QM-600-6	230	425/850
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—150	G.E.	MPC	230	250/450
1—150	Cr. Wh.	CCM	230	300/1050
1—150	G.E.		600	250/750
10—150	Cr. Wh.	83H	230	800
1—150	Cr. Wh.	CMC-65H	230	1150
2—125	G.E.	CO-1832	230	625
1—125	El. Dy.	30S	230	750/1500
1—115	Cr. Wh.	JHL	230	1200
3—101	Whse.	SK	230	485/950
1—50	G.E.	CDM-12422	115	1800
1—50/100	G.E.	CD-175	230	365/730
2—80	El. Dy.	30S	230	475/1350
1—75	Cr. Wh.	CMC	230	500/1500
1—75	Whse.	SK-100L	125	650
2—75	El. Dy.	25-SL	230	750/1750
3—60/75	Whse.	SK-200	115	300/700
4—75	Cr. Wh.	53-H	230	860
2—75	G.E.	CDM-11269	230	2000
1—60	Whse.	SK-160	550	680
1—60	El. Dy	25-S	230	525/1050
1—60	Whse.	SK	230	500/1000
1—60	Whse.	SK-131	230	500/1500
1—60	El. Dy.	25S	230	750/1500
2—50	G.E.	RCP-311B	230	1700
4—50	Whse.	Hoist	230	400
1—50	Whse.	SK-153	230	690/1035
1—50	Cr. Wh.	CMC-80H	230	380/750
1—40	Whse.	SK-103	230	1800/2400
2—35	G.E.	RF-14	230	250/1000
2—30	G.E.	CD-115	230	500/1500
7—25/30	G.E.	CD-105	230	690/2070
3—25	Whse	SK-93	230	1310/1750
2—20	Whse.	SK-90	230	1150
1—20	Whse.	SK-93	230	1750
2—20	GE	CD-103	230	400/1600

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Auto Extraction 250# 18P 15# Ext. 2400V. 3 ph. 60 cy.
1	2000	G.E.	Condensing. 175# 18P—6600V. 3 ph. 60 cy.
1	1000	G.E.	Condensing 135/150# 18P 2300/4150V. 3 ph. 60 cy.
2	750	G.E.	Condensing 250/275# 18P 440V. 3 ph. 60 cy. (New 1944)
1	450	Whse.	Condensing 250/275# 18P 440V. 3 ph. 60 cy.
1	300	G.E.	Non-condensing 150/175# 18P 5/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# 18P Geared to 1200 RPM.—125V. D.C. Gen.
2	200	Cr. Wh.	Condensing 250# 18P Geared to 1200 RPM.—125V. D.C. Gen.
1	200	Whse.	Non-condensing 150# 18P 7# B.P. 240V. 3 ph. 60 cy.
	100	G.E.	Non-condensing 150# 18P 2300V. 3 ph. 60 cy.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4600	514
2—2000	Whse.		2300	120
1—1000	Whse.		2300	1893
2—900	Al. Ch.	(New)	2200	150
1—650	Whse.	NG	2200	138
1—600	Whse.	Syn.	440	360
1—500	G.E.	ATI	480	900
1—500	G.E.	TS	4150	600
1—450	Whse.	Enz.	2300	128.5
2—350	G.E.	TS	2200	150
1—320	G.E.	ATI	2300	600
1—300	G.E.	ATI	440	720
1—300	Whse.		2300	720
1—300	Al. Ch.		440	600
1—145	G.E.	ATI	550	720
2—125	G.E.	ATI	440	450
1—100	Whse.		550	600
2—100	G.E.	TS-7651	440	450
1—100	G.E.	TS	440	1800
1—100	E.M.	Unused	440	600

SLIP RING

1—1000	Whse.	CW	2300	700
2—700	Whse.	CW	2300	900
1—500	G.E.	IP	550	505
1—500	G.E.	IM-MIII	2200	450
3—450	G.E.	IM	440	506
1—400	G.E.	IM	440	720
3—350	Whse.	CW	2200	900
1—350	G.E.	MT-442Y	2200/4000	253
1—300	Al. Ch.	3 Brg.	2300	505
1—300	G.E.	IM	440	720
9—300	Al. Ch	ANY	2200	705
1—250	G.E.	MT-424Y	4000	257
1—250	G.E.	MT-5598	2200	1750
4—100	G.E.	MT-506Y	440/2200	425
2—100	G.E.	IM-16	2200	435
3—100	G.E.	IM	440	600
3—100	Al. Ch.	AK	2200	1200
1—75	Whse.	CW-761	2300	1750
1—60	Cr. Wh.	123-AQ	220	700
3—50	Whse.	CI-638A	220	870
2—50	Whse.	CIW-50	440	870

SQUIRREL CAGE

1—250	G.E.	KT-559	440	800
1—200	G.E.	IK	550	865
1—200	G.E.	KT-557	440	1800
1—125	Whse.	M8	440	485
1—125	(New) G.E.	KF-TEFC	440	1190
1—125	G.E.	KF-TEFC	440	3585
2—100	Al. Ch.	AR	2200	1170
1—100	G.E.	IK-Vert.	2300	450
2—100	G.E.	KT-543	220/440	1750
1—200/112	GE	KF-559BS	440	1170/885

TRANSFORMERS

60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
1	2500	Packard	AT	3	13800x2300
1	2500	Al. Ch.	OISC	3	13200x2300
3	1000	Pitts	OISC	1	13200x2300
2	1250	G.E.	H	1	6900 x 550
1	1650	G.E.	WCTH	3	11000 x 445
1	1000	Maloney	OISC	3	13200 x 480
1	600	Penn	OISC	3	13200 x 120/208
1	600	Al. Ch.	OISC	3	4000/2300 x 216
3	333	Pitts	OISC	1	26400 x 2600
3	250	Al. Ch.	OISC	1	2280 x 130
3	200	Whse.	OISC	1	7200 x 240/480
6	167	G.E.	OISC	1	2400 x 240/480

SPECIAL OFFERING

1 Set—36 New Factory Armature Coils. For 1250 KW G.E. Generator Rigid Frame. Type ATB2—3600 RPM, 3 phase, 60 cycle, 480 volts.

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BREW-WOLTMAN OFFERS

TURBINE UNITS

1—12500 KVA Al. Ch. Cond. 60 cy. 6900 V. 250-lb. 600 deg. Surface Condenser
1—12500 KVA Al. Ch. Cond. 60 cy. 13800 V. 240-lb.
1— 9375 KVA Cond. 50 cy. 13800 V. 600-lb. 825 deg. Surface condenser & boiler. NEW.
1— 5000 KVA G. E. Non-C. 60 cy. 13200 V. 600-lb.
2— 5000 KVA West. Cond. 60 cy. 13800 V. 240-lb.
2— 4500 KVA West. Cond. 60 cy. 6600 V. 200-lb.
1— 3125 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lbs., 40-lbs. BP
1— 1563 KVA G. E. Ext. 60 cy. 2300 V. 400-lb. IP, 100-lbs. Ext. Cond.
1— 1250 KVA DeLaval Non-C. 60 cy. 2300 V. 250-lbs.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lbs.
1— 940 KVA Elliott Cond. 60 cy. 480 V. 400-lbs.
1— 125 KVA West. Non-C. 60 cy. 240/480 V. 150-lbs., 5-lbs. BP.
1— 25 KW Allis Non-C. DC 125 Exciter Dual drive turbine & motor.

BOILERS

2—509 HP B. & W., 200-lb., 488 deg.
1—507 HP Comb. Engr. 400-lb. 620 deg. Oil.
2—253 HP B. & W. 225-lb. Bent tube.
2—200 HP Erie Economic 125-lb. Stokers.
1—180 HP Frost 200-lb. Return tubular.

DIESEL ENGINE UNITS

2—1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
2— 900 HP M.A.N. 2300 V. 60 cy. NEW.
1— 720 HP Amer. Loco. 240 V. DC
1— 625 HP Worth. 240 V. 60 cy. gen.
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 400 HP DeLaVergne 2400 V. 60 cy.
1— 375 HP Worth. 240 V. 60 cy. gen.
2— 240 HP Fair. Morse 2400 V. 60 cy.
1— 150 HP Gen. Motors 3-378A-60-3-480
2— 125 HP Murphy 240 SV. 60 cy.

NEW
MOTORS
STOCK
20 — 200 HP

SYNCHRONOUS MOTORS—60 CY.

2—3000 HP G. E. 2300 V. 257 RPM
1— 880 HP G. E. 6600 V. 514 RPM
1— 600 HP G.E. 440 V. 360 RPM
2— 500 HP E. M. 2200 V. 514 RPM
3— 400 HP E. M. 440 V. 600 RPM
1— 350 HP G. E. 440 V. 900 RPM
1— 300 HP G. E. 2300 V. 600 RPM
1— 300 HP West. 2300 V. 900 RPM
1— 250 HP West. 600 V. 180 RPM
1— 250 HP G. E. 550 V. 400 RPM
1— 200 HP G. E. 220 V. 600 RPM

INDUCTION MOTORS—60 CY.

1—8000 HP Cr. Wh. S/R 2200 V. 895 RPM
1—7200 HP S/R 11000 V. 750 RPM 25 cy.
2— 450 HP West. S/C 4150 V. 360 RPM
1— 300 HP West. S/R 2200 V. 1770 RPM
1— 250 HP G. E. S/R 2200 V. 1800 RPM
1— 200 HP Cr. Wh. S/C 2300 V. 900 RPM
1— 200 HP Cr. Wh. S/C 2300 V. 720 RPM. NEW.
1— 200 HP G. E. S/R 2200 V. 435 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1800 RPM. NEW.
1— 150 HP Cr. Wh. S/C 440 V. 1200 RPM. NEW.
1— 150 HP Cr. Wh. S/C 440 V. 900 RPM. NEW.

MOTOR GENERATOR SETS

1—1500 KW West. 250 V. DC 60 cy.
2—1000 KW G. E. 600 V. DC 60 cy.
1— 500 KW G. E. 250 V. DC 60 cy.
4— 94 KW G. E. 60 V. DC 60 cy.
1— 75 KW Star 240 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.
1— 18 KW West. 60 V. DC 60 cy.

ROTARIES—60 CY.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2025/2565 KW Gen. Elec. 225/285 V.
2—2000 KW Gen. Elec. 600 V.
2—1500 KW Westinghouse 270 V.
1—1000 KW Westinghouse 660 V.

MERCURY ARC RECTIFIERS

2—4500 KW Multi Anode 600 V. DC
2—3250 KW Ignitron 650 V. DC
1—1850 KW Ignitron 275 V. DC

FREQUENCY CHANGERS

1—12500 KVA G. E. 25/60 cy. 300 RPM
1— 1250 KVA West. 25/60 cy. 300 RPM
1— 2500 KVA G. E. 25/60 cy. 300 RPM
2— 1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS—60 CY.

4— 333 KVA West. 432000—7620/13200
1—2000 KVA G. E. 69000—13800/23900, 3 ph.
3— 500 KVA G. E. 66000—13200/6600
3—1000 KVA West. 66000—11000
4—1000 KVA G. E. 66000—2400/4150 V.
1—5000 KVA West. 34500—13750 3 ph.
1—5000 KVA G. E. 33000—2300/4000, 3 ph.
1—3000 KVA West. 33000—2300/3990, 3 ph.
6— 50 KVA G. E. 33000—2300
6— 75 KVA Moloney 33000—2300/6900
3—3750 KVA West. 26400/13200—2400
4— 450 KVA Al. Ch. 25410/14000—13280/23000
1— 750 KVA G. E. 13200—480, 3 ph. Unit Sub.
2— 200 KVA G. E. 11500—230
3— 200 KVA Moloney 11000—2300
3— 167 KVA G. E. 7200/12400—240/480
1—1500 KVA West. 4000—2300, 3 ph. Auto.
3— 250 KVA Al. Ch. 2300—460
3— 500 KVA Pittsburgh 2300—230/460
3— 20 KVA West. 2200—575/287½
12— 15 KVA Standard 4600/2225—117/234
2—27½ KVA G. E. 440—220/110

OIL CIRCUIT BREAKERS

1— 400 A. 73 KV G. E. FHKO-236 Outdoor
1— 400 A. 73 KV G. E. FHKO-136 Outdoor
1— 600 A. 73 KV G. E. FHKO-139 Outdoor
3— 400 A. 37 KV West. G-11 Outdoor
1—1200 A. 25 KV G. E. FHKO-256 Outdoor
2—1000 A. 23 KV Kelman CB-76 Outdoor
4— 600 A. 15 KV G. E. FHKO-138BS Outdoor

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TURBO-GENERATORS

2—New 4000 KW Cond. 2400/4160 V. 750° T.T.
1—3500 KW 2300 V Cond.
1—2500 KW 600 V Cond.
1—2500 KW 2300 V Cond.
1—2000 KW 600 V Cond.
1—1500 KW 480 V. Extract 400±
1—1500 KW 2300 V Cond.
2—1250 KW 2300 V Cond.
1—1000 KW 2300 V Non-C.
2—1000 KW 440 V Cond.
1—1000 KW 480 V. Extract 300±
1— 750 KW 480 V. Extract 145±
1— 750 KW 600 V Extr.
1— 600 KW 240 V Cond.
1— 400 KW 480 V Non-C.
1— 250 KW 2300 V Non-C.

TURBO-GENERATORS (Continued)

1— 250 KW 240 V Non-C.
1— 150 KW 2300 V Non-C.
1— 125 KW 600 V Extrac.
1— 100 KW 600 V Non-C.
1— 50 KW 220 V Non-C.

TURBINE—Only

1—New 465 HP—3550 RPM 900 PSI.

WATER-WHEEL GENERATORS

2—250 KW Vert. 21' Hd. 3 ph. 60 cy—550 volts

ENGINE GENERATORS

1—900 KW NEW Skinner Uniflow 2400/4160 volts
1—500 KW 2300 V Unit.
1—400 KW 125 V Unit.
1—375 KW 2300 V Unit.
1—168 KW 220 V Unit.
1—168 KW 550 V

BOILERS

2—40,000± 200±
2—30,000± 425±
1— 623 HP 450±
1— 487 HP 200±
1— 300 HP 200±
1— 220 HP 160±
1— 200 HP 175±
6— 200 HP Sterling 160±
2— 190 HP 160± NEW

AIR COMPRESSORS

1—6000 CFM 50± Motor
2—2000 CFM 100± Motor
1—1700 CFM 100± Motor
2—1299 CFM 100± Motor
1—6000 CFM 5.1± NEW
1—5000 CFM 10± Rotary Type Motor

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

The Buyers Must Be Satisfied—Always

MOTOR GENERATORS

1—400 KW West. Syn. 600 V. DC, 720 RPM, 2300/4000 V. AC, 3 P., 60 C.
2—300 KW G.E. Syn. 250 V. DC, 1200 RPM 440/2300/4600 V. AC, 3 P., 60 C.
1—200 KW G.E. Syn. 250 V. DC, 1200 RPM 2300/4000 V. AC, 3 P., 60 C.
1—150 KW G.E. Syn. 250 V. DC, 1200 RPM 2300/4000 V. AC, 3 P., 60 C.

SYNCH. CONVERTERS

1—500 KW West. 250 V. 6 P., 60 C. 1200 RPM, 2300/4000/6900/13,200 V. Trans.
1—300 KW G.E. 250 V. 6 P., 60 C. 1200 RPM, 440/2300/4000/13,200 V. Trans.
1—300 KW G.E. 600 V. 6 P., 60 C. 1200 RPM, 2300/4000/6900/13,200 V. Trans.

WALLACE E. KIRK COMPANY
502 Grant Building, Pittsburgh, Pa.

asme—BOILERS—nat'l. b'd.

4—404 HP sectional header oil burners
1—400 } Erie City, low head (3) drum, oil,
2—500 } complete plant, 1942.
2—600 HP Stirling type low head spreader stokers complete plant 1942
3—84" suspended HRT single settings
Capacities based on 100% rating

HARRY BREARLEY
34-23—91st Street, Jackson Heights, N. Y.

GLOW

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh.
350	3550	2200	Westgh.-CS
300	1800	440	Al.-Ch.
300	900	440	GE-I-17
250	1200	440	GE-KTR
250	600	2300	Triumph
225	514	440	GE-I-14
200	490	2200	GE
200	600	440	Westg'h-CS
150	1200	440	GE Type I
150	600	2200	GE
125	3600	220/440	Al.-Ch. AN
125	1200	440	Century
125	340	220	A-C
100	1800	2300	Burke
100	1200	2200	Al.-Ch. AR
85	3600	2200	GE
75	1800	220/440	GE-K505S
75	1200	220/440	GE-K505Y
75	900	2300	GE
60	3600	2300	GE-KT
60	1800	220/440	A-C AR
60	1800	2300	GE-FTR
60	900	440	GE-KT346
50	3600	440	R. & M.
50	1800	220	Triumph
50	1200	2200	GE-KT343
50	900	220	GE
50	720	2300	Wtg.-CS
40	1800	220	A-C
40	1200	550	A-C AN
40	900	440	GE-KT
40	900	2300	Wtg.-CS
40	720	440	GE-KT
35	600	440	GE-Type I Form M
30	1800	440	A-C
30	1200	dual	Master
30	900	220	Al.-Ch.-AR, fr. 220e
30	900	220	Wagner (HI-Torque)
30	720	220	GE-RJ
30	514	440	Stanley
25	3600	dual	L-A
25	1800	dual	GE
25	1200	220	Weache
25	900	440	GE

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GE-TE-FC-BB
75	1200	2200	GE-TE-FC-BB
60	900	440	GE-TE-FC-BB
30	900	440	Reliance, TE-FC-BB
20	3600	dual	Delco-TE-FC-BB
20	1200	440	Wagner
20	900	440	GE-TE-FC-BB
15	1800	dual	Delco
15	1200	220/440	Delco-TEFC-BB
15	900	440	GE-TE-FC-BB
10	3600	220/440	F-M
10	1800	220/440	Delco
10	1200	440	GE-TE-FC-BB
7½*	1800	dual	Wagner-TEFC-BB
7½*	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-Hi Slip-TE-BB
7½	1200	dual	Delco
7½	1090	220/440	GE-Hi Slip
7½	900	dual	Delco-TEFC-BB
5	3600	dual	Delco-TE-FC-BB
5*	1800	dual	Master-TEI C-BB
5	1800	220	Wagner TE-B BB
5*	1200	dual	GE-TEFC-BB
5	3600	dual	Delco, TE-FC-BB
3	1800	dual	Delco-TEFC-BB
3	1200	dual	Rel-TEFC-BB
3	900	dual	Delco
2	1800	dual	Delco-TEFC-BB

*New Motor

ENCLOSED SQUIRREL CAGE—Cont'd.

HP	RPM	Volts	Make
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	900	dual	Delco-TEFC-BB
1½	1800	dual	L. Al-TE-BB
1½	1200	dual	Delco-TEFC-BB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1	1200	220	GE-KT
¾	3600	440	Delco-TE
¾	1800	dual	Weache-TE-BB
¾	900	dual	Delco-TEFC-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco-TE-BB

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
375	1800	2300	Al. Ch.
350	900	2300	Westgh.
300	720	2300	Al. Ch.
250	720	440	GE-Type MT
250	300	2300	Al. Ch.
235	1800	220	GE-I
200	1800	440	Al.-Ch.
125	1800	2200	Westgh. Type CW
75	1800	220	GE
75	900	440	Al.-Ch., ANY
75	720	2200	Wagner Type BR
75	380	550	GE Type I
75	360	220	GE Type I
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Weache
50	1800	220	GE-MT
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
40	1200	220	GE-MT-336
40	900	220	A-C
40	720	2300	Wtg.-HF
40	720	220	Al. Ch.-ARY
40	600	2300	Al. Ch.-ARY
40	600	220	Al. Ch.-ARY
40	450	220	Triumph-C
35	900	220	Al. Ch.
35	900	2300	Ridgeway
35	720	220	GE
35	900	2200	GE
30	1800	2300	Wtg.-CW
30	1800	2300	GE
30	1200	440	Wagner
30	600	220	F. Morse-BV

VERTICAL MOTORS

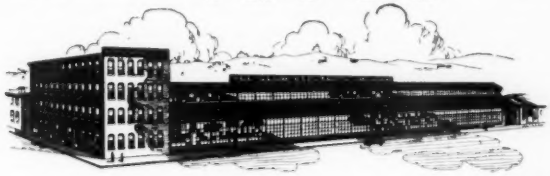
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
150	1200	2200	GE-I-SR
150	1200	440	GE-Cage
125	1200	2300	Al. Ch.-SR
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
75	1200	2200	GE-Cage
75	360	220	Ideal-Cage
60	1800	230 D.C.	GE
60*	1200	440	Al. Ch.-Cage

VERTICAL MOTORS—Cont'd.

HP	RPM	Volts	Make
50	1200	2200	Wtg.-Cage
50	600	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
40	1200	2200	Westgh.-BB-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg.
20*	1200	440	Al. Ch.-Cage
20	800	230 D.C.	GE-RC
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al.-Ch.
12½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
7½	1800	500 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C.	GE
6	850	110 D.C.	Rel.
5	1400	115 D.C.	R. & M.
5	600	440	GE-Cage
4	1850	110 D.C.	Watson
3	3500	dual	Delco
3	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	GE-ATI
1015	500	2200	Wtg.-25 cycle
710	720	13200/6600	GE
500	514	440	GE
435	720	2300	GE TYPE ATI
320	900	2300	GE-ATI
250	1800	2300/4160	GE-ATI
250	225	2300	GE-ATI
225	900	4100	GE-ATI
220	600	2300	GE-ATI
200	225	2300	Wtg., rotor & stator only
175	225	220	GE-TS (rotor & stator only)
160	600	440	GE-ATI
160	164	480	GE-TRF (rotor & stator only)
150	1800	2200	GE
150	1800	220	GE-ATI, Single Bearing
150	720	440	Westgh.
120	225	220	E-M, rotor & stator only
115	164	208	GE
100	1200	220	Wstg Single bearing
95	1200	220	Burke
75	1200	220	Westgh.
75	900	2300	GE-ATI-7552
60	360	2200	GE, rotor & stator
50	1200	440	Wagner
50	900	220/440	Westgh.
50	720	440	GE-TS
50	360	440	GE, rotor & stator
50	300	220/440	Wtg. (rotor & stator only)
30	900	440	Wagner
30	600	550	GE, rotor & stator
30	450	dual	Wtg., rotor & stator
30	360	550	GE
30	327	220	E-M, rotor & stator
25	1800	220	Wagner
25	450	220	E-M, rotor & stator
20	1200	440	Wagner
20	900	220	Wtg.
20	600	220	E-M, rotor & stator



D. C. MOTORS

115 Volts

HP	RPM	Description
225	750	GE-NYSC
60	1200	Star
50	120	Al.-Ch.
35	975	Northern
30	1800	F-M
30	200/600	Sprague
25	1150	Triumph
25	780	GE-MPC
20	700	Triumph
20	500/1500	GE-RF11
20	400/1200	GE-RLC fr. 202A
18	900	Sturtevant MPs
15	1200	J. & L.
15	1000	GE-CE
15	975	F-M
15	725	Westgh.-S fr 6
12	1075	J. & L.
12	530	Westgh.-SK-113
10	3450	Imperial
10	650	J. & L., type CI
10	400/1600	Watson-BW15B

GEAR HEAD MOTORS

DIRECT CURRENT

HP	OUTPUT RPM	VOLTS	DESCRIPTION
¼	24	230	Roth
⅓	167	110	Janney-Shunt
1	7.64	115	Master-compound
1	23	115	Master-compound
1	780	115	Crocker-Wheeler-Back Geared
1	200	110	Rt. M-Back Geared
1	458	115	Master-compound
1	850	115	Triumph-compound
1	8	115	Master-compound
1½	27.5	115	Master-compound
2	8.35	115	Master-compound
2	20.1	115	Master-compound
3	85	230	C-W
3	123	115	Master-compound
3	144	115	Master-compound
3	437	230	Westgh.-shunt
3	627	110	Master-compound
7½	84	115	Westgh. with speed reducer
7½	256	230	C-W-shunt
10	2030	230	Westgh. TKBB

D. C. GENERATORS

125 Volts

KW	RPM	Description
540	1000/1300	Westgh., single bearing
500	750	GE-MCF
300	1500	GE-CC
200	900	GE-MPC
200	800	GE-DMC
100	1000	WE-DLC
100	900	Wstg.-SK single bearing
55	1000	GE-Type TD
40	800	J. & L.-F Ped. Type
35	1165	GE-DLC
31.25	1400	Westgh.-SK-single bearing

D. C. GENERATORS

230 Volts

KW	RPM	Description
400	1200	Wstgh. single bearing
200	1200	GE-MPC single bearing
175	450	Westgh.
125	1400	Westgh.-SK-130L
50	1200	Al. Ch.-E-127
35	1800	GE-RC
30	300	Triumph
22½	765	Westgh.-SK
20	1750	Delco Ballbearing
18	300	Burke
15	350	Westgh.-SK

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AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

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PRICES ON ALL BOILERS

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IMMEDIATE DELIVERY

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Scotch Cylindrical Return Tube
Built by Union Iron Works Co.
2 Furnaces, coal fired
T.S. 60,000 lb.

Cleaver Brooks
Fire Tube Marine Package Type 60 H.P.
100 lb. Max. Working Pressure
2,000 lb. Steam per hr. at 35 lb. pressure.

Yarrow 3 Drum Bent Tube
Max. Steam per hr. 65,000 lb.
Normal 55,000 lb.
Working Pressure 225 P.S.I.
Test Pressure 387 P.S.I.
Heating Surface 6256 Sq. Ft.

NUMEROUS OTHER ITEMS ARE AVAILABLE FOR INDUSTRIAL USE

Wickes Water Tube, 3 Drum
55,000 lb. Steam per hr. normal
65,000 lb. Steam per hr. max.
628 H.P.
Working Pressure, 250 lb.

Babcock & Wilcox Water Tube Boilers
22,500 lb. Steam per hr.
Working Pressure 250 P.S.I.
Heating Surface 487.4 Sq. Ft.

MILNOR & BLEIGH STS. • *Phone MAyfair 4-1400* • PHILA. 35, PA.

NEW and REBUILT ELECTRIC POWER EQUIPMENT

Squirrel Cage Motors—3 Phase

H.P.	Make	TYPE	SPEED
250(2)	G.E.	KP359	1800
200(2)	G.E.	IK	450
150(2)	G.E.	IK	600
150	West.	CS-856C	900
150(3)	Century	864N585W	1200
150	West.	CS	1800
150	G.E.	KT5478	1800
125	G.E.	K-542Z	1200
125	Century	864N584W	1200
125(2)	G.E.	K586	1200
125	G.E.	IK	600
100	A. C.		720
100	West.	CS762C	900
100	G.E.	KTP513	1800
100	C. W.	CW35R	1800
100(2)	West.	CS445	3600
75	G.E.	IK	450
75	G.E.	IK	514
75 (5)	G.E.	IK	600
75	F.M.	BH23A	600
75 (2)	G.E.	KT356	720
75 (3)	G.E.	IK	720
72	West.	CS	720
75 (6)	G.E.	IK	900
75	G.E.	KT352	900

Synchronous Motors—3 Phase

H.P.	Make	TYPE	SPEED
350	G.E.	ATI	600
300	G.E.	TS-974Y	720
220	G.E.	ATI-PB	600
200	G.E.	ATI-6304D	257
150	G.E.	TS-7641	720
145(3)	West.	6C1258	1200
108(2)	G.E.	TS954Y	1200
75	G.E.	ATI-PC	900

Squirrel Cage—2 Phase

H.P.	Make	Type	Speed
50 (4)	West.	CS	1200
40	West.	CS	1200
30	West.	CS	720
25	F. M.	H12B	900
25	West.	CS	1750

3 Phase—25 Cycle—Motors

H.P.	Make	Type	Speed
200	G.E.	IM	720
150	West.	HP	360
150	G.E.	IK	720
100	G.E.	IM	485
100	G.E.	MTC5353	750
100	Lincoln	TQ	750
100	West.	CS (Gr. Bd.)	900
75	G.E.	IK	500
75	G.E.	IK	750
75	West.	CW-779C	750
50	Century	8C50	750
50	Burke	N-5058	1500
40 (2)	G.E.	MTC-5303	750

Slip Ring Motors—3 Phase

H.P.	Make	Type	Speed
450	West.	CW	500
300	G.E.	MTC5560Z	600
275	G.E.	I	360
150	AL Ch.	ANY	600
150	F. M.	HV-220C	1800
125	G.E.	MT-562	600
100	G.E.	IM	1800
75	AL Ch.	ANY	600
60	G.E.	MTC-5546	600
60	G.E.	MT-546	900
52	Oil	55A	720/240
50	G.E.	IM	450
50	G.E.	IM	720
50	G.E.	MT-552	720
50	G.E.	MT542	900

Slip Ring Motors—2 Phase

H.P.	Make	Type	Speed
150	G.E.	MQP540	1800
2	G.E.	IQC5012	900
50 (6)	A. C.	ANY 26C	900
50	G.E. (Vert.)	MQ536	1200
40	A. C.	ARY	720
30	A. C.	ARY-220C	900
25	A. C.	ARY	600
25	A. C.	ARY220C	900

Partial List Only

230 Volt—DC—Motors

H.P.	Make	Type	Speed
150(3)	C. W.	8JH(TEFC)	900
150	G.E.	CDP125	1800
135	Burke	WAM-15	1200
112(4)	C. W.	HHL	1750
100	G.E.	CDM1239Y	1200
100	Elec. Dyn.	10SM	1800
90	West.	SK-1-80-H	575
62½(3)	West.	SK123L	1750
60 (2)	G.E.	CDM-95	1800
50 (2)	G.E.	CO-2007	470
50	West.	CK9	600
50	West.	SK220	94/170
50	G.E.	MLC204	500/1500
50 (12)	Burke	WA6S	1450
40	C. W.	50H	750/1000

Partial List Only

115 Volt—DC—Motors

H.P.	Make	Type	Speed
100	G.E.	CDMY1212Y	1200
80	C. W.	CMC-50H	1200
65	G.E.	CDM-1135Z	1200
60	C. W.	CMC125H	240/300
25	G.E.	RC31B	1200
15	West.	CK7	850
15	West.	SK83	1200
15	G.E.	RC29A	1750
15	Elec. Spec.	U52	1750
15 (2)	West.	SK	1750

Partial List Only

SPECIAL

3—150/100/75/50 H.P.—3/60/440 v 1800/1200/900/-600 RPM—G.E.—KT559AS—BB DP — motors with CR-7950Y1 controls.

SPECIAL

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91 JAY STREET **PHONE MAIN 4-5900** **BROOKLYN 1, NEW YORK**

AVAILABLE FOR IMMEDIATE DELIVERY FROM STOCK

POWER PLANT EQUIPMENT

STEAM ENGINE GENERATOR SETS

2—575 KVA Skinner Unaflow—West. 240/480 V.
1—575 KVA Allis-Chalmers Corliss—220/440 V.
1—375 KVA Ames Vertical 220/440 V.
1—250 KVA Ridgeway four valve 2300 V.
1—187 KVA Ames Vertical 220/440 V.
1—156 KVA Ames Vertical 220/440 V.

STEAM TURBINE UNITS

Complete 2000 KW Turbo-Generator Plant:

1—1500 KW G.E. condensing—3600 RPM
1—500 KW G.E. condensing—3600 RPM
These units are of modern design, are 3 phase, 60 cycle, 2300 V.

DIESEL GENERATING UNITS

4 Diesel Generating Units, like new, comprising a complete diesel power plant, and consisting of two 450, one 300, and one 150 HP Fairbanks-Morse model 32-E engine-generator units. Engines are of all duplicate cylinder size, 2400/4160 V, 3 phase, 60 cycle, Late model Woodward governors, pumps, cooling tower, etc. Operated only a short time. Available for immediate delivery.

1—250 KVA—220/440 V. G.M. "twin"—NEW—not war surplus.

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MUtual 9151

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AC DIESEL GENERATORS

Several 1000 KW, 2300V, Fairbanks Morse, O.P., 720 RPM w/New Elliott or Crocker Wheeler Generators.
Several 600 KW, 2300V, G.M.C., 12 cyl., 720 RPM, w/New Crocker Wheeler Generators.
Several 400 KW, 2300/480V, Baldwin, 6 cyl., 450 RPM, w/New EMCO Generators.
1—300 KW, 240/480V, G.M.C. 8 cyl., 1200 RPM.

DC DIESEL GENERATORS

1—610 KW, Cooper Bessemer, 8 cyl., 950 H.P. w/G.E. 500V, 750 RPM Generator.
10—300 KW, Baldwin/Westinghouse, 120/240V, 3 wire, 448 HP, 400 RPM. Like New.
2—300 KW, G.M.C., 8-268A, 120/240 volt, 3 wire, 1200 RPM.
Several 100 KW, GMC, 3-268A, w/Allis Chalmers, 120/240V, 3 wire Generators.
Several 100 KW, Superior, 8 cyl. w/Delco, 120/240V, 3 wire Generators.

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

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50,000 lb. Integral Furnace 400 lb. B & W boiler complete with pulverized coal burners.
1500 KW 2400 volt GE Cond. turbine nozzled 150 lbs capable changing pressure up to 400 lbs.
225 KVA 240 volt Chuse Uniflow engine set.
100 KW 250 volt GE Rotary Converter with 2300 volt transformers.
200-150-100 & 50 KW Syn. M. G. Sets 2200 AC 250 DC

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MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

PROMPT SHIPMENT — PARTIAL LISTING

VARIABLE VOLTAGE DRIVES

40 HP Reliance Variable Voltage Drives, each Consisting of:
1—40 KW 250 Volt Induction M-G Set with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

On.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220	G.E.	MT-532
2	10	1140	440	West.	HF-7A
2	10	870	220	G.E.	HI-11
2	11‡	820	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	870	220	West.	CW-446
1	18	880	440	West.	MW-316
1	20	880	440	West.	CW-838
1	25	1180	550	G.E.	MT-523
2	25	880	220	Wagner	BR
2	25	730	440	Wagner	23VBB
1	30	885	440	West.	CW-446
1	30	850	440	G.E.	MT-532
1	30	875	440	G.E.	MT-336
2	35	800	440	F-M	HV-B16A
2	40	885	220	Al-Ch.	ARV-223C
1	40	580	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	850	440	West.	HF-12A
1	50	870	440	G.E.	MT-552
5	52‡	550	220	G.E.	IQC-5013***
1	60	885	440	West.	CW-758
1	60	870	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-6352
2	125	450	440	G.E.	IT-16
2	150	1760	440	G.E.	MTP-549
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
3	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-E15A
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	600	1770	440	G.E.	IM-F15C
1	850**	900	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts.
‡Intermittent rating. ***2 phase.
**New ‡‡25 Cycle.

230 VOLT CONST. SPEED D. C. MOTORS

On.	H.P.	Speed	Make	Type
20	2	850	West.	SK-20
7	3**	1150	Al-Ch.	EB-71
10	3	850	Reliance	Y-23T
25	3¼	850	West.	SK-30
1	7½	1150	G.E.	CDM-86
8	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.-Ch.	EB-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
5	15	825	West.	SK-90
1	20	1750	L.A.	ONA-1851
11	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-18
1	60	1750/1310	West.	SK-143
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D.C. MOTORS

On.	H.P.	Speed	Make	Type
10	1½/2	500/2000	G.E.	CD-65
1	2	225/900	Reliance	78T
1	5	450/1800	G.E.	CD-83
2	6	450/1800	G.E.	RF-9
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
2	10/15	600/2400	Reliance	T-92T
1	12½	280/840	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	400/1600	Reliance	T-230-T
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	800/1800	West.	SK-143
1	47/50	400/1200	Reliance	T-461T
3	75	500/1800	G.E.-Wa.	CM
1	75	375/750	G.E.-Wh.	CMC-125H
5	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/500	West.	SK-220
2	375	350/500	G.E.	MPC

**New.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

On.	H.P.	RPM	Volts	Make	Type
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXPF
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-WS04
1	40	3565	440	G.E.	KF-4058

Splashproof, Ball Bearing

On.	H.P.	RPM	Volts	Make	Type
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
2	50	1760	440	L.A.	FX-445A
3	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-4335
1	200	885	440	L.A.	FS-1378

Open Type Motors

On.	H.P.	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-113247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3478	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	C.E.	FTR-522
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
2	25**	875	440	Master	PB-405
2	25	875	440	G.E.	KT-542
5	30	3550	550	G.E.	K-3648
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RPS-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-546
1	75	1160	440	West.	CS-664
1	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-552
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	435	440	Al.-Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	450‡‡	G.E.		KT-5668
1	500	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

220 volt motors can be reconnected for 440 volts.
**New ***2 Phase.
‡‡ Reconnectable for 440 volts.

G. E. DYNAMOMETERS
Cradle Type, with Control and Dial Scale
(Write for Complete Specifications)

On.	HP	D.C. Volts	RPM	Type
1	50/75	250	1650/4000	TLC-20
2	100	250	1050/3600	TLC-50
1	200	250	1200	C

MOTOR GENERATOR SETS
125 and 250 Volts D. C.
(Write for complete Specifications)

KW	Make	RPM	D.C.Volts	A.C.Volts
2	Cont.	1750	125	220/440
7.5**	West.	1455	125	380/220‡
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440‡
16	West.	1750	125	2200/440
20	West.	1750	250	220/440
25	G.E.	1800	250	220/440
25	G.E.	1200	125	220/440
30	G.E.	1800	250	220/440
30	Al-Ch	1750	125	220/440
30	West.	1750	250	220/440
50	G.E.	720	125	220/440†
75	G.E.*	1200	125	220/440
75	G.E.	1200	250	2300/440
100	Columbia*	1200	250	2300/440
150	West.*	1200	250	2300/440

Note: 3KW, 5KW and 7.5 KW, 250 Volt Sets Also Available.
**New *Synchronous Motor Driven.
‡60 Cycle. †25 Cycle.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. CLEVELAND 14, OHIO

POWER PLANT MACHINERY

CONDENSING EXTRACTION TURBO UNITS

3 phase 60 cycle

25000 KVA G.E., 13800 volts, 400# steam.
12500 KVA Allis, 13200 volts, 250# steam.
6000 KVA (2) G.E., 4000 volts, 600# steam.
2500 KVA G.E., 2400/4150 volts, 400# steam, 5# extraction.
2250 KVA G.E., 2300 volts, 400# steam.
1560 KVA Allis, 240 volts, 180# steam, 5# extraction.
1250 KVA Allis, 480 volts, 300# steam, 35# extraction.
1250 KVA G.E., 4000 volts, 400# steam.
1250 KVA G.E., 2300 volts, 200# steam, 5# extraction.
940 KVA Westgh., 600 volts, 200# steam, 25# extraction.
750 KVA G.E., 480 volts, 200# steam, 15# extraction.
625 KVA Westgh., 2400/4160 volts, 450# steam, 5# extraction.

NONCONDENSING TURBO UNITS

3 phase 60 cycle

5000 KVA G.E., 13800/6900/4000 volts, 600# steam, 150# extraction, 50# exhaust.
1563 KVA G.E., 2400 volts, 250# steam, 20# exhaust.
1250 KVA DeLaval, 4150/2300 volts, 400# steam, 125# extraction, 60# exhaust.
750 KVA Murray, 220 volts, 250# steam, 30# exhaust.
625 KVA G.E., 240 volts, 175# steam, 5# exhaust.
250 KVA (2) G.E., 480 volts, 150# steam, 15# exhaust.
156 KVA Murray, 600 volts, 225# steam, 35# extraction, 10# exhaust.

BOILERS

212,000# per hour B & W, 600# steam, oil fired.
50,000# per hour B & W, 400# steam, coal pulverizer.
40,000# per hour Vogt, 450# steam, chain grate stocker.
40,000# per hour B & W, 200# steam, chain grate stoker.

UNIFLOW UNITS

3 phase 60 cycle

1125 KVA Skinner, 4160/2400 volts, 175# steam, surface condenser.
750 KVA Skinner, 2300 volts, 160# steam, 5# exhaust.
625 KVA Skinner, 240 volts, 150# steam, 5# exhaust.
500 KVA Skinner, 450 volts, 130-160# steam, 5# exhaust.
312 KVA Skinner, 480 volts, 115-140# steam, 5# exhaust.
200 KVA Skinner, 240 volts, 125-140# steam, 3# exhaust.

SPECIAL

500 KW General Electric direct current generator, 115 volts, direct connected to Erie Ball corliss engine, 115# steam, 5# back pressure, 150 RPM.

Excellent condition.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

Modern Equipment

DIESEL ENGINES

HP	MAKE	MODEL	RPM	CYCLE	YEAR
1800	General Motors	16-258S	900	4	1943
1600	Fairbanks Morse	38D8½OP	720	2	1944
1600	Hamilton	HB99-D.A.	700	2	1944
1600	General Motors	16-278A	720	2	1944
1200	General Motors	12-278A	750	2	1944
1200	General Motors	16-184A	1800	2	1943
900	General Motors	12-567ATL	750	2	1942/44
800	General Motors	6051 Quads	650	2	1943
500	Superior	6-cyl.	514	4	1942
300	Fairbanks Morse	38-O/P	1200	2	1936
225	General Motors	6-71	2100	2	1943
150	Superior	GDB-6	1200	4	1942/44
80	Hercules	DWXDS	1800	4	1943

DIESEL GENERATOR SETS

AC	200 KW	3/60/450	1200 RPM	General Motors	8-268A	1943	Rebuilt
	100 KW	3/60/450	1200 RPM	General Motors	3-268A	1943	1948
DC	1200 KW	525V	750 RPM	General Motors	16-278A	1943	
	650 KW	240V	750 RPM	General Motors	12-567	1943	
	290 KW	120/240	1200 RPM	General Motors	8-268A	1944	
	125 KW	120/240	600 RPM	Superior	VDMB	1944	
	100 KW	120/240	1200 RPM	Superior	GDB-8	1942/44	
	100 KW	120/240	1200 RPM	General Motors	3-268A	1943/44	
	60 KW	120V	1200 RPM	Buda	909	1942	
	10 KW	120V	1200 RPM	Hercules	DOOD	1943	

MOTORS—D.C.

1500 HP	525 V DC	600 RPM	Whse.
667 HP	374 V DC	1300 RPM	Elliott.
444 HP	250 V DC	900 RPM	Elliott.
222 HP	230 V DC	3050 RPM	Whse.
15 HP	120 V DC	500 RPM	Diehl

MOTORS—3 phase, 60 cycle

3800 HP	1700V	257 RPM	General Electric
700 HP	2300V	128 RPM	Electric machine
60 HP	440V	427 RPM	Gearmotors
40 HP	440V	561 RPM	Gearmotors
20 HP	440V	1760 RPM	General Electric

Ask for our new 1949
CATALOG

TURBO-GENERATORS—A.C.

1—1000 KW All. Chalmers 3/60/600, 3600 RPM, cond., 140# steam press.
2—250 KW G.E. type AT1 3/60/450, 1200 RPM, cond.
2—200 KW Westinghouse, 3/60/450, 1200 RPM cond. (NEW).
6—200 KW G.E. type ATB 3/60/450, 1200 RPM cond. and non cond.
2—132 KW G.E. type ATB 3/60/450, 1200 RPM, cond.

TURBO-GENERATORS—D.C.

KW	Volts	Winding	Speed	Type
2—375	180/240	Shunt.	1200	non-cond.
5—300	120	Compd.	1200	cond.
1—300	240	Compd.	1200	cond.
8— 60	120	Stab. Sh.	1800	cond.

CONDENSERS

Most are new

No.	Sq. Ft.	Make	Passes	Tubes
4	3300	Str. Wells	2	Alu Brass ¾"
1	2200	Alco	2	Cu Ni ⅝"
4	1050	Conseco	2	Cu Ni ⅝"
15	400	All.Chalm.	2	Brass ⅝"

WRITE OR CALL FOR DETAILS

HUGO NEU CORPORATION

31 Nassau Street New York 5, N. Y.
Tel. REctor 2-1334

ARRANGE FOR INSPECTION

POWER EQUIPMENT—READY TO SHIP

A.C. MOTORS—3 PH. 60 CY.

No.	H.P.	Make	Type	RPM	Volts
2	300	G.E.	I	1150	2200
1 NEW	200	Westg.	Syn	1200	220/440
2 Vert.	250	G.E.		1200	2200
2	250	G.E.	I	1150	2200
2	200	G.E.	I	860	2200
1	200	Westg.	CS	900	2300/4000
1	200	G.E.	Syn.	1800	2200/550
1	175	Westg.	MS	1200	220/440
1	150	Westg.	Syn	257	240/480
1	150	Westg.	CO 3568A	580	4000/2300
1	150	Westg.	Syn.	600	220/440
1 NEW	150	Elec. Mach.		720	4160/2300
1	150	Westg.	Syn	900	2300
1	150	Westg.	Hi-torq.	1200	220
3	150	Louis Allis	FX	1775	220/440
1	150	Westg.	CS	720	4000/2300
1	125	Elec. Mach.	Syn.	164	220/440
1 NEW	125	Elec. Mach.		585	4160/2300
1	125	G.E.	IK	900	220/440
1	125	Westg.	CS	600	220/440
1	125	Westg.	Hi-torq.	1115	220/440
1	125	Westg.	CS	3600	220/440
1	112	Westg.	Syn.	1200	220/440
1	100	Reliance		495	220/440
1	100	Westg.		580	220/440
1	100	G.E.		600	220/440
1	100	G.E.	IK	720	220/440
1	100	Allis Chal.		720	220/440
1	100	G.E.	I K	900	900/440
1	100	Westg.	Hi-torq.	830	220/440
1	100	Westg.	Syn.	900	220/440
1	100	Armour	AB	1750	220/440
1	100	Louis Allis	0028	1750	220/440
1	90	G.E.	I K	600	220/440
1	75	Stanley		600	220/440
1	75	Allis Chal.		585	220/440
1	75	Westg.	CS	660	220/440
1	75	G.E.	I K	600	220/440
1	75	G.E.	I	720	220/440
1	75	Elec. Mach.	Syn.	900	220/440
1	75	Louis Allis	0028	1200	220/440
1	75	Burke		1200	220/440
1	75	Louis Allis	FAA	1150	220/440
1	75	G.E.	KT	1150	220/440
3 tefc	75	Master	FX	1750	220/440
1 tefc	75	Westg.	CS	1750	220/440
1	60	Allis Chal.		514	220/440
1	60	G.E.	I K	600	220/440
1	60	Burke		900	220/440
1	60	G.E.		900	220/440
1	60	Triumph		1200	220/440
1	60	G.E.	KT	1800	220/440
2	50	G.E.	KT	720	220/440
1	50	Cr. Wh.		900	220/440
1	50	Wagner		900	220/440
1	50	Triumph	H	860	220/440
2	50	G.E.	KF	860	220/440
2	50	Westg.	CS	860	220/440
2	50	G.E.	KT	1200	220/440
1	50	Wagner	CP	1750	220/440
2	40	G.E.	KT	570	220/440
2	40	Westg.	CS	685	220/440
1	40	Cr. Wh.		720	220/440

SPECIAL BARGAINS
Diesel Engine Generator Sets

1—100 KW., 120/240 V.D.C. Delco Generators dir. con. to 150 HP., Model GBD-8, 5½x7, 8 cyl, Superior Diesel Engines, elec. start, power panel, accessories. Practically new—only used for spares

4—100 KW., 220/440 V. A.C. 3 ph. 60 cy. West. Gen. dir. con. to 150 HP. Superior Diesels same as above

2—100 KW., 220/440 V. A.C. 3 ph. 60 cy. West. dir. con. 150 HP. General Motors DIESEL Model 3-268A, 3 cyl.

2—75 kva. 220/440 V. A.C. 3 ph. 60 cy. Delco dir. con. Cummins Diesel engines

2—37½ kva. 220/440 V. A.C. 3 ph. 60 cy. dir. con. Buda Diesel Engines

1—NEW 7½ kva. 120/V. 3 ph. 60 cy. Wisconsin GASOLINE

10—3 kva. 120 V. single or 3 phase, 60 cy. Hobart A.C. Generators dir. con. to Hercules GASOLINE ENGINES with panels

SLIP RING MOTORS—3 ph. 60 cy.

No.	H.P.	Make	RPM	Volts
2	800	West. CW	507	6600
1	200	West. CW	1800	220/440
1	150	West. CW	1150	2200/220/440
1	125	West. CW	860	2200/220/440
1	100	West. CW	720	2200/220/440
1	100	Triumph C-17	580	550/440/220
1	75	G.E.I-M	720	220/440
1	75	West. CW	1800	220/440
1	60	West. CW	900	220/440
1	60	G.E.	570	220/440
1	60	Burke	1200	220/440
1	60	G.E. 1M	720	220/440
4	50	West. CW	870	2200/220/440

VARIABLE SPEED MOTORS—230 V. D.C.

No.	H.P.	Make	Type	RPM
1	200	Westg.	SK-210	500/2000
2	200	Reliance	1970-T	400/1200
1	100	Westg.	SK-190	500/1000
1	100	Westg.	SK	600/1200
1	75	Westg.	SK	1100/1800
2	75	Westg.	SK	850/1700
1	75	Westg.	SK-151	250/1000
1	60	Westg.	SK-150	875/1750
1	50	Westg.	SK-151	250/1000
1	50	Westg.	SK-101	850/1050
1	50	Westg.	SK-143	850/1750
1	40	Cr. Wh.	CMC	500/1500
1	20	Westg.	SK-123	400/1600

AXIAL FLOW VENTILATING FANS

25—6000 cfm Sturtevant Bulletin 512389, 2" stat. pres. 7 blade, dir. con. 5/1.5 HP., 1765/1175 rpm., 220/440 v. 3 ph. 60 cy. West. TEFC Motors.

A. C. GENERATORS—3 ph. 60 cy.

No.	KVA.	Make	RPM	Volts
1 new	250	Westg.	1200	220/440
1	100	Elec. Mach.	164	220/440
1	100	Westg.	600	220/440
1	75	Elec. Mach.	900	200/440
1	50	G.E.	1200	220/440
1 new	50	Elec. Mach.	1200	220/440
1	37½	Ft. Wayne	1200	200/440
1 new	25	G.E.	900	220/440

MOTOR GENERATOR SETS—250 V.D.C.
Motors 220/440 volt or 2200 volt 3 phase, 60 cycle

No.	KW	Make	RPM
3	250	Westinghouse	1200
1	200	Westinghouse	720
2	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Delco	1200
2	90	Westinghouse	680
4	75	Westinghouse	720
1	75	Westinghouse	1200
1	60	Westinghouse	1200
1 NEW	50	General Electric	1800
5	40	Westinghouse	900
2	30	Westinghouse	720

125 V. DC M.G. Sets

1—100 kw. G.E. 125 v. 900 rpm. 220/440 v. 3 ph. 60 cy. AC Syn.

1—75 kw. West. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. Syn.

ENGINE GENERATOR SETS

1—125 kva. 220/440 v. 3 ph. 60 cy. 257 rpm. Erie Ball STEAM.

1—125 kva. G.E. 220/440 v. 3 ph. 60 cy., dir. con. Skinner UNIFLOW Engine.

BRAND NEW TURBO SET

Westinghouse Steam Turbine consisting of 200 kw., 220/440 v., 3 ph. 60 cy. 1200 rpm., 80% P.F. A.C. Generator—40 kw., 120 v. 1200 rpm., D.C. Exciter and Westg. Reduction Gear.—Non-cond.

SPECIAL BARGAIN AIR COMPRESSOR

6—240 CFM Westinghouse type 3 VS-23 3 cyl. vert., 150 lbs. pres. dir. con., to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

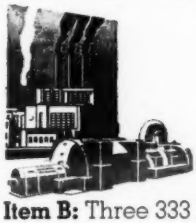
DIESEL ENGINES

2—1800 HP Fairbanks-Morse, Model 38D 8⅛, 8⅛"x10", 800 RPM, 10 cylinder, air start, solid injection, complete with auxiliaries. Excellent Condition.

Unused 450 HP Enterprise Diesel engine, Model DSG-6, 6 cyl., 4 cycle, 450 RPM, air start, solid injection.

OTHER SIZES IN STOCK

ALJOHN DIESEL CO., INC.
904 Pacific St., Brooklyn 16, N. Y.
STerling 3-6515



Item A: New—never erected—two 190 HP, 3-drum boilers. 160#. With underfeed stokers, soot blowers, fans, controls. Cost $25,000. Sacrifice at $17,000.

Item B: Three 333 KVA transformers. Single phase. 2400 primary. 220/440 secondary. Almost new. $3,150.

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CINCINNATI, OHIO.

MAIN 5873 UNION TRUST BUILDING MAIN 3427

BOILERS

10 to 1000 H.P.

NEW-USED RECONDITIONED

Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
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MURRAY HILL 7-6547-8-9

FOR SALE
GEAR TRANSMISSION

300 HP Sturtevant
2515 to 900 RPM Design #3

ELECTRIC APPARATUS REPAIR CO.
1400 No. 6th St., Phila. 22, Pa.

10,000 KW TURBO GENERATOR, 240#, 1800 RPM

2500 KW. Cond. 250#, with 800 HP Boiler

300 KW. DIESEL ENGINE SET, 300 RPM

STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave., N. Y. 33, N. Y.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220/440 VOLTS

H.P.	Make	Type	Frame	RPM
50	Fairbanks Morse	H16B	Ball Bearing	750
75	Fairbanks Morse	H16G	B.B. Sliding	750
150	Gen. Elect.	IK	2300	750
75	Gen. Elect.	IK		1500
100	Allis Chalmers			1450
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1155
200	Westinghouse	CS	2200 volt	1500
350	Westinghouse	CW	Slip Ring	500
500	Gen. Elect.	IK		485
660	Gen. Elect.	MT	8Hp Ring	490
600	Westinghouse	CS		490

INDUCTION HEATING SET

GENERATOR—175 KVA General Electric A.C. Generator, type A.S.C. form AL, single phase, 800 volts, 3000 cycle, 1800 RPM, serial #5513629.

GENERATOR EXCITER—4 KW. General Electric Generator type EE, form EB, 125 volts, D.C., 1800 RPM, 8 amps., serial #1758709.

MOTOR—300 HP General Electric synchronous motor, type TS, form EL, 3 P.F., 3 phase, 60 cycle, 440 volts, 1800 RPM, serial #5513628.

MOTOR EXCITER—3 KW. General Electric Generator, type EF, form EB, 125 volts, D.C., 1800 RPM, 24 amps. serial #1758750.

Motor and Generator are direct connected, 4 bearing. Mounted on factory fabricated base, with direct connected exciters.

3000 Cycle Control is mounted in cubicle also containing 300 HP General Electric synchronous motor starting control.

3 PHASE 550 VOLTS 25 CYCLE MOTORS
Write for our stock list of approximately 500—3/25/550 Voltmotors

700 KW M.G. SET

2—350 KW Gen. Elect. Type MPC 250 volt, 720 RPM Generators will direct connect to 1000 HP Synchronous Motor or will sell Generators separately.

200 KW M.G. SET

200 KW Westinghouse NEMA Frame Generator 250 Volt D.C. 1200 RPM, direct connected to 300 HP Westinghouse Synchronous motor 2300 208 1200 RPM A.C.—D.C. Panels Like New

Immediate Shipment

SLIP RING MOTORS
3 Phase—60 Cycle—220/440 Volts

H.P.	Make	Type-Frame	Speed	Remarks
2—20	LA1	KH	900	
20	G.E.	MT-202	1800	
30	Gr. Wh.		1800	
3—35	West.	CW	585	
35	G.E.	MT-342	690	
35	West.	MW	688	
40	West.	CW-718A	690	
6—40	G.E.	MT-356	1200	
40	G.E.	MT-525	1800	
50	G.E.	MT-356	1200	
50	G.E.	MT-527	1800	
2—50	West.	CW	1800	
60	G.E.	MT-533	1800	
60	West.	CW-6536	1800	
100	West.	CW	435	2 bearing
2—100	G.E.	I form M	900	
2—100	G.E.	MT-547	1800	
125	G.E.	I form M	1200	
2—250	G.E.	I form M-16	900	
250	West.	CW	435	2200 volts
500	Al. Ch.	ANY-WR	514	2200 volts
600	G.E.	MT	190	25 cycle

This motor will rewind satisfactorily to 700 G.E. MT 720

HORIZONTAL & DUPLEX
Compressor & Vacuum
Pumps after Coolers, Filters

NEW TRANSFORMERS
Stock Shipment

2—25 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—25 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—37½ KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—37½ KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—50 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
3—50 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
1—75 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
9—100 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
2—100 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
6—150 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—167 KVA Niagara O.I.S.C. 2400/100/240, 1 Phase, 60 cycle, with taps.
3—250 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—333 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.

TRANSFORMERS

1—100 KVA Gen. Elect. Transformers Type H Form KF—5700/1166 volts primary 120/240 volts secondary. Price $150.00 each. Electrically O.K. F.O.B. track, Minneota.
2—50 KVA Gen. Elec. Transformers Type H Form K—1 Phase 60 Cycle 2300 Volts Primary 115/230 Serial No. 3154858.
1—200 KVA Westinghouse Transformers Type SK—1 Phase 25 Cycle 2300 Volts Primary 115/230 Volt Secondary. Serial No. 1214689-90-91.

PLATING GENERATOR

3000 Amp. Hansen Van Winkle 6—12 volt, 400 RPM

FREQUENCY CHANGERS
All Sizes in Stock. 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 cycle and any other high cycle.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

MOTORS AND CONTROLS
AT REDUCED PRICES!

NEW SLIP RING
220/440 VOLTS

Qu	HP	RPM	Mfg.	Shaft
1	100	720	Elliott	3½ x 6
1	125	720	Elliott	4 x 12
2	500	1200	Elliott	4½ x 8

All sealed sleeve bearings, on original skids.
New control available for each motor.

Reconditioned and guaranteed

SLIP RING

HP	RPM	Volts	Mfg.
500	450	2300	G.E.
450	514	440	Whse.
400	514	2300	Allis
300	600	2200	Whse.
250	600	440	G.E.
200	1200	440	G.E.
150	1200	2300	G.E.
100	600	440	G.E.
75	1800	220	G.E.
60	900	220	G.E.
50	1200	220	G.E.

M. G. SETS

600 KW MG SET
250 volts D.C. 440 volts A.C., G.E., with syn. motor. Complete with control. Nearly new.

KW	DC Volts	AC Volts	Mfg.
500	250	2300	G.E.
400	250	2300	G.E.
300	250	2300	G.E.
250	250	2300	C-W
200	250	2300	Whse.
150	250	440	G.E.
100	250	440	Star
75	250	440	Star
50	250	220/440	Rel.
30	250	220/440	Rel.

Reconditioned and guaranteed

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
650	138	2300	Whse.	Engine
600	450	2300	G.E.	80%
500	600	2300/4160	G.E.	80%
400	720	440	G.E.	80%
350	900	440	G.E.	100%
300	514	440	G.E.	100%
250	600	4160	E-M	100%
150	900	4160	G.E.	80%
75	900	220	E-M	80%

NEW DIRECT CURRENT
230 VOLTS

Qu.	HP	RPM	Mfg.	Frame
3	3	690/2660	G.E.	284
15	5	850/1700	G.E.	CD-66
5	7½	575/1750	G.E.	CD-77
4	7½	575/1750	Rel.	T-46
3	10	1750/2200	Rel.	T-34
5	30	850/1700	Rel.	T-230
2	75	400/1200	Rel.	T-651
2	75	1750	E-M	1509
1	250	1750/2300	CW	

Drip proof—ball & sleeve bearing

Reconditioned and guaranteed
DIRECT CURRENT
230 volts Adjustable Speed

HP	RPM	Mfg.
200	300/900	Whse.
200	400/1200	Rel.
150	400/1200	Whse.
125	400/1200	Rel.
50 100	600/1200	Rel.
100	500/1500	Whse.
100	300/900	Rel.
75	500/1500	C-W
60	400/1200	Whse.
50	300/1000	Whse.
40	500/1500	L-A
25	400/1200	G.E.

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BOSWICK ELECTRIC CO.

WAlbridge 1195
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WAR SURPLUS BARGAIN

120 KVA — 460 VOLT
3 PHASE — 60 CYCLE

DYKANOL

Indoor Dust-Tight · Rack Type
Cornell-Dubilier

CAPACITORS

LIST PRICE $1580.00

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While they last!

$400.00

PORTER

ELECTRIC COMPANY, INC.
116 THIRD AVE. NO.
MINNEAPOLIS, MINNESOTA

ROTARIES AND M. G. SETS

1—2000 KW Allis-Chalmers Rotary Converter 600 volt D.C.

1—1500 KW Westinghouse Rotary Converter, 600 volt D.C., fully automatic.

1—1250 KW Allis-Chalmers *Motor Generator* Set, 600 volt D.C., 4000 volt A.C.

1—1000 KW General Electric Rotary Converter, 600 volt D.C., 4000 volt transformers.

We have substations of all sizes and voltages.

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New and Guaranteed Rebuilts
Save 40% to 60%

BRAND NEW — BARGAIN
466 CFM 110± CHICAGO PNEU 0-CB

SPECIALS
270 CFM 125± SULLIVAN "UNITAIR"
388 CFM 125± WORTHINGTON M-75

PORTABLE COMPRESSORS
OILLESS FOR INSTRUMENT CONTROL
66 CFM—4x5 INGERSOLL ER-1
89 CFM—4x7 INGERSOLL ES-1
93 CFM—5x6 INGERSOLL ER-1
173 CFM—9x8 CHICAGO PNEU

MANY OTHER MAKES AND SIZES AVAILABLE—LIST 147

AMERICAN AIR COMPRESSOR Corp.
Dell Ave. & 47th St., North Bergen, N. J.

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REBUILT EQUIPMENT

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- Transformers
- Compressors
- Switchboards
- Controls
- Hoists and Cranes
- Pumps

For fast service and engineering assistance

PHONE CANAL 6-2900 TODAY

MOTOR GENERATOR SETS

Capacity	Description
1500 KW—WESTG.	gen. 250 V. comp'd 500 RPM
2110 HP—WESTG.	syn. motor 3/25/660 V. .8PF 3 Ped. brg. construction on cast sub-base
1563 KVA—GEN. ELEC.	type TS AC gen. 3/60/2300 V. 900 RPM. .5PF.
1250 HP—GEN. ELEC.	type TS syn. motor 3/60/2300 V. 1 OPF. 3 Ped. brg. construction on fab. sub-base
1250 KW—AL. CH.	type HIC gen. 550/600 V. comp'd. 300 RPM.
1700 HP—AL. CH.	type Bullock syn. motor 3/60/4000 V. 1 OPF. 3 Ped. brg. construction on cast sub-base
1200 KW—GEN. ELEC.	type MCF gen. 125/250 V. 3 wire comp'd. 720 RPM.
1700 HP—GEN. ELEC.	type TS syn. motor 3/60/5000 V. .8PF. 3 Ped. brg. construction on cast sub-base
500 KW—GEN. ELEC.	type MPC gen. 230 V. comp'd. 720 RPM.
700 HP—GEN. ELEC.	type ATI syn. motor 3/25/2300 V. .8PF. 3 Ped. brg. construction on cast sub-base
500 KW—GR. WH.	type CD gen. 575 V. comp'd. 720 RPM.
625 KVA—GR. WH.	syn. motor 3/60/2300/4000 V. 1. OPF.
10 KW—Dir. Conn.	exciter. 2 Ped. brg. construction on cast sub-base
500 KW—WESTG.	gen. 125 V. comp'd. 720 RPM.
700 HP—WESTG.	syn. motor 3/60/2300 V. .8PF. 3 Ped. brg. construction on cast sub-base
500 KW—GEN. ELEC.	type MPC. gen. 250 V. comp'd. 900 RPM.
700 HP—NEW AL. CH.	type AB syn. motor 3/60/2300 V. .8PF. 2 Bracket—1 ped. brg. construction on fab. sub-base
500 KW—GEN. ELEC.	type MPC gen. 250 V. comp'd. 720 RPM.
710 HP—GEN. ELEC.	type ATI syn. motor 3/60/440 V. 1 .OPF. 3 Ped. brg. construction on cast sub-base
500 KW—GEN. ELEC.	type MCF gen. 1200 V. comp'd. 720 RPM.
700 HP—GEN. ELEC.	type ATI syn. motor 3/60/4000 V. .8PF.
12 KW—Dir. Conn.	exciter type MP 125 V.

SQUIRREL CAGE MOTORS

HP.	MAKE	TYPE	VOLTS	SPEED
750	GE	KT	2300	720
700	GE	KF-56947	2300	1800
600	Westg.	CS-6-34-15	4150	1200
500	GE	IK	2300	1800
500	GE	KTP-567	440	1200
500	GE	IK	440	900
400	GE	IK	2200	1800
400	Westg.	CS-936	2200	1800
400	GE	IK	440	600
350	Westg.	CS	2200	900
350	GE	IK-14	440	514
300	GE	K-559BZ	440	1200
300	GE	IK	440	900
250	Westg.	CS-875-S	2200	1800
250	GE	IK	2200	900
250	GE	IK	2300	600
200	Wagner	26-V	440	1800
200	Westg.	CS	2300	1200
200	GE	K	2300	720
200	GE	IK	440	450
150	Westg.	CS	2200	1200
150	GE	IK	2300	600
150	GE	KT-564	2300	500
125	GE	IK	2300	1700
100	Al. Ch.	ARZ-504-S	440	3600
100	GE	KT	2300	1800
75	Al. Ch.	AP-223-BS	220/440	1800

SLIPRING MOTORS

HP.	MAKE	TYPE	VOLTS	SPEED
1000	Westg.	CW	2200	720
800	Westg.	CW	6600/440	507
750	GE	MT-16	2200	450
700	Westg.	CW	2200	720
600	GE	IM	440	350
600	Cr. Wh.	SR	6600	514
500	Ideal	AV-590	2200/4000	1800
500	GE	IM	2300	720
500	Al. Ch.	ANY	440	600
400	GE	MT-412	2300	440
400	Al. Ch.	ANY	4000	514
350	Westg.	CW	440	720
350	Al. ch.	ANY	440	585
300	Westg.	CW	2300	367
300	GE	IM	440	450
300	Al. Ch.	ANY	2300	720
250	Al. Ch.	ANY	2300	300
250	Westg.	CW	480	600
250	Cr.Wh.	QSR	440	600
250	Westg.	CW-32-B	440	900
200	GE	IM	2300	600
200	Westg.	CW	2200	600
150	GE	IM	440	450
150	GE	IM	2300	720
125	GE	IM	2300	720
100	GE	IM	440	450
100	Westg.	CW	440	575
100	Al. Ch.	ANY	440	720
75	GE	IM	440	514
75	GE	IM	440	600
75	Cr. Wh.	250	440	600

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1—400 H.P. Erie City Boiler 200± P.S.I. ASME—with Fryr Spreader Stoker and Forced Draft Fan—in service—1937—18,000± capacity—straight tube box headed—excellent condition—F.O.B. Lebanon cars $5000—immediately available.

1—Six panel Westinghouse Switch gear (600-400-200-200-150-100 amps) 2400 volt, 60 cycle completely equipped—Available November or December.

B. W. JOHNSON, *City Manager*

MARVELOUS VALUE

506 HP BROS Watertube Boiler with Waterwalls & Bros Spreader Stoker. Capacity 43,000± steam; 200± w.p., Performance Like New. Has Saved $20,000.00 per year on Fuel. Very Low Price for Quick Sale.

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Diesel Gasoline and Steam Generators, Electrical and Industrial Equipment

POWERITE CORPORATION
140 Cedar St. New York 6, N. Y.
Dept. 105 BA 7-8199

Most all units still on foundation. Many may be seen operating

TURBO UNITS (Cond.)

1800 KVA GE Package Type 400#
1563 KVA GE 2300 v., 225#
1250 KVA Al. Chal. 480 v., 300# (bleeder)
1250 KVA (2) Elliott 480 v., 150/200#
1250 KVA Wghse. 2300 v., 450#
1250 KVA GE 4150 v., 200#
937 KVA Al. Chal. 480 v., 150# (bleeder)
750 KVA GE 240/480 v., 150/200#

TURBO UNITS (Non-Cond.)

625 KVA GE 2300 v., 150/200#
600 KVA GE 480 v., 150/200#
250 KVA GE 600 v., 150/200#
250 KVA Wghse. 480 v., 300#
62½ KVA; 112 KVA; 125 KVA; 200 KVA and 250 KVA GE 480/220 v. units

DIESEL UNITS

500 KVA GE-Worthington; 2300 v.
282 KVA Wghse.-Winton; 240/480 v.
200 KVA FM-FM: 2400/480/240 v.
156 KVA Ideal-Buckeye 240/480 v.
109 KVA GE-Superior 240/480 v.
93 KVA GE-Superior 480/240 v.
75 KVA (2) GM 2400/480/240 v.

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625 HP Vogt bent tube 450#
605 HP Union bent tube, 3 drum, 200#
540 HP Keeler 250#
460 HP Lasker-Adams bent tube 250#
400 HP Erie City, Heine type, 200#
250 HP Wickes bent tube, 3 drum 160#

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900 KVA GE-Skinner Unif. ver. (new)
450 KVA GE-Ames Unif. Cond.
312 KVA GE-Chuse 4 v.
312 KVA GE-Ames Unif.
312 KVA (2) CW-Skinner Unif.
250 KVA GE-Chuse 4 v.
187 KVA GE-Chuse 4 v.
187 KVA Wghse.-Ames Unif. Ver.
62½ KVA GE-Ames Unif.

PUMPS — MOTOR DRIVEN

COMPRESSORS — MOTOR DRIVEN

TRANSFORMERS

MOTOR GENERATOR SETS

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

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1—140,000# New Steam Generator 600#, also 450#
2—90,000# Boilers, 625#, 825° F.tt., Economizer and Air-heater
2—60,000# MODERN Boilers 450#
2—40,000# MODERN Boilers, 250#
2—30,000 MODERN Steam Generators 450#
2—1040 HP Heine Boilers—Super 200#
3— 750 HP Stirling Type Boilers 200#
1— 400 HP B&W Co. Sectional—Super 200 to 350#
4— 509 HP B&W Sectional Header 200# Boilers.
2— 350 HP Straight Tube 200# Boilers
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

1—20,000 KW Turbo-Generator—Cond.
1—10,000 KW Turbo-Generator—Cond.
1— 7,500 KW Turbo-Generator—Cond.
1— 5,000 KW Turbo-Generator—Cond.
2— 2,500 KW same as above
3— 2,000 KW same as above } Also 400 & 600# Turbos
2— 1,500 KW same as above
2— 1,250 KW same as above
2— 1,000 KW same as above
1—500 KW same—Also 750 KW & 300 KW Units
Non-Cond.:—300 - 500 - 750 - 1000 - 1500 - 2000

COMPLETE STEAM PLANTS: One with 2-1500 KVA's, One of 2500 KVA & One of 7500 KVA.
Frequency Changers—Transformers! Send us your requirements—We may have it.
Send us your INQUIRIES *for* ALL POWER MACHINERY

CHARLES B. REARICK **30 CHURCH ST.** **NEW YORK 7, N. Y.**

For quick sale and removal by purchaser—Two 72" HRT Boilers, 150 HP & 200 HP respectively—now operating and insured for 125#—with stokers, brushing & dampers, steam heater and all trimmings—$1250 for the two—at Newton, Ill. municipal plant.

H & H ENGINEERING SERVICE
5120 Prospect, Kansas City 4, Mo.

TRANSFORMERS

FOR SALE

2—150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6—100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. **Philadelphia 20, Pa.**

REBUILT EQUIPMENT

12—General Electric Type FKR55-20
600 Amperes, 15000 Volts,
Oil Circuit Breakers,
3 Pole, 125 Volt DC Solenoid Operated,
150,000 KVA I. C.
Angle Iron Frame Mounted.

PRICED FOR QUICK SALE

JOSEPH SATIN CO.
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MODERN DIESEL GENERATING PLANTS

450 HP Fairbanks-Morse Diesel Engine, 6 cylinder, series 32-E-14, 300 RPM, direct connected to 300 KW Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.
300 HP Fairbanks-Morse Diesel Engine, 4 cylinder, series 32-E-14, 300 RPM, direct connected to 200 KW Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.
30 KW Ready-Power Portable generator sets.

DENNY & CLARK
1923 W. North Ave., Chicago 22, Ill.

FOR SALE

1—Norberg Uniflow Engine, 14x20, direct connected G.E. Generator, 125 KW, 240/3/60, with switchboard and voltage regulator. Excellent running condition.

1—Ames 12x12 Single Baker Valve Engine, direct connected G.E. 50 KW, 230/3/60 Generator, with switchboard.

1—100 HP, self-contained, Union Universal Boiler, 150# pressure.

CHARLES V. FISH
501 Commonwealth Bldg., Allentown, Penna.

FOR SALE

Speed Reducers and Couplings

2—Falke, parallel shaft units, 275 HP, 1750 RPM input, 481 RPM, output, Steel Case, UNUSED.

2—Falke, Steel Flex, Size 17 FA, Couplings, 2⅞ x 3" Bores. UNUSED.

FLUSHING ELECTRIC CORPORATION
45-07 162nd Street **Flushing, N. Y.**
FLushing 9-5417-4937

STEEL STORAGE TANKS

2—1000 & 2—10,000 Bbl. New Vertical
6—74,000, 55,000 & 37,500 Bbl. Vert.
8—25,000 Gal. Cap. Horizontal
50—10,000 & 3—20,000 Gal. Horizontal
8—10,000 & 12,000 & 18,000 Gal. ⅜" Shell
20—10,000 Gal. Cap. 60 lb. Press. Test

STANHOPE, Rosemont, Penna.

BOILER FEED PUMP

600 GPM, 2310 ft. hd., 6 stage, Worthington, Type 4-UX-2, connected to 500 HP Allis-Chalmers Motor, 440/3/60, Control.

New—Never Used.

DELL STEPHENSON & CO.
2565 GUARDIAN BLDG., DETROIT 26, MICH.

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Steel—Iron—Brass
Industrial & Marine Piping Supplies
"If it's a valve, we have it"

H. P. SHERMAN COMPANY
134 Dupont St. **Brooklyn 22, N. Y.**
EVergreen 8-3300

SLIP RING MOTORS

3-Ph., 60 Cy.

HP	Volts	Make	Speed
440	440/220	Whse.	514
300	2300/550	G.E.	900
250	2200/440	Whse.	600
200	440/220	Whse.	514
200	440/220	Whse.	900
200	2300/440	G.E.	1200
200	440	G.E.	450
150	440/220	Whse. (2)	1800
150	2300/440	G.E.	1200
150	440/220	G.E.	720
100	440/220	G.E.	600
100 (2)	440/220	Whse.	900
100	2300/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800
75	440/220	Whse. 25 cy.	750

SYNCHRONOUS MOTORS

3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
600	2300/440	G.E.	T.S.	1200
400	440/220	G.E	ATI	600
300	2200/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
240	440/220	Whse.	G	1800
200	440/220	G.E.	TS	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2300/440	Whse.	GE	600

GENERATOR SETS

1—63¼ kva, 1200 rpm, 220 volt, Whse., geared to 7300 rpm, Whse., non-cond. steam turbine, 150 lbs. pr.
2—unused 25 kva, 120/208 v., 3 ph., 1200 rpm, generator dir. conn. to Waukesha 6 cyl. gas engine

AIR COMPRESSOR UNIT

1—13" and 9" by 10" Worthington FEATHER-VALVE, 235 rpm. 110 lbs. sq. motor-driven.

CIRCUIT BREAKERS

2—2000 amp., 60 E. 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse. 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
300	2200/550	Whse.	CS	1800
250	2200/440	L. Allis	OGS	1200
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	S. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G. E.	IK	514
135	440/220(3)	G. E.	IK	514
125 vert.	440/220	G.E.	KTP	1200
100	550	Cr. Wh.	Q	900
100	2300/440	G.E.	K	1200
60	440/220 (new)	L. Allis	OGA	1800

A. C. GENERATORS

1—500 kva, 1200 rpm, 2300/440 v., G.E.
1—320 kva, 600 rpm., 440/220 v., G.E.
1—250 kva, 720 rpm., 2300/440 v., G.E.
1—250 kva., 600 rpm., 2200/440 v., G.E.
1—225k va 600 rpm., 220/440 v., G.E.
210 kva, 1830 rpm, 440/220 volt, Westinghouse
100 kva 100 rpm, 440/220 volt, Westinghouse
1—112 kva 900 rpm., 440/220 v. G.E.
2—75 kva, 1800 rpm., 440/220 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
260	230 (2)	G. E.	CD	1150
250	230 (2 new)	CMC	CMC	1800
200	230	Cr. Wh.	CMC	890
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	635
100	230	G.E.	CD	1780
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—250 kw, 1200 rpm, 250 v., 3 wire, conn. to 500 hp 1200 rpm, 2300/440v., G.E. syn.
1—165 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/220 v., squirrel cage
1—150 kw, 900 rpm, 240 v., Cr. Wh., conn. to 225 hp, 900 rpm, 2200/550 v., squirrel cage.
1—125 kw, 1200 rpm, 250/120 v., G.E., conn. to 175 hp, 1200 rpm, 4000/2300/440 v., synchronous
1—75 kw., 125 v., 1200 rpm., G.E. conn. to 120 hp., 2200/440 v., syn. motor.
1—50 kw., 250 1200 rpm., G.E. conn. to 75 hp., 440/220 v., 60 cy., G.E. syn. motor.

TRANSFORMERS

60 Cy.

3—500 kva, Al. Chal, 2400-480 v.
1—400 kva., G.E. 2300-230/115
3—250 kva., Whse. 2400—240/480 volts
3—200 kva, G.E., 2400—240/480 volts
3—200 kva, Moloney, 4150/7200Y—120/240 volts
2—150 kva., G.E., 13800/6900-*10/220 v.
1—150 kva., Whse. SK, 13200-125/215 v., 3 ph
3—150 kva, G. E., 2300—230/460 volts
3—100 kva, G. E., 13800—230/115 v, NEW
6—100 kva., G.E., 4600/2300-230/115. NEW.
3—100 kva, G.E., 450-115/230 v., dry, 1 ph., new
4—100 kva, G.E., 440/220—220/110 v.
5—75 kva. G.E., 2400-240/120 v.
3—75 kva., G.E., H-KF, 2300-230/460 v

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HARRY J. RICE PRES.

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1 340 HP VOGT 200 Psi Boiler
2 DEAN Bros. 250 Psi Duplex Water Pumps
1 Weinman 500 GPM Centrifugal Pump
1 Daton-Dodd 1000 GPM Centrifugal Pump
1 200 KW Skinner Steam Engine-Generator Set
1 200 KW Ames Vertical Steam Engine-Generator
1 525 CFM Ingersoll-Rand Air Compressor
1 425 CMF Ingersoll-Rand Steam Driven Compressor
1 200 Ton Vilter Ammonia Compressor
1 150 Ton H & C Ammonia Compressor W/Steam Engine
1 100 Ton H & C Ammonia Compressor W/Steam Engine
1 250 HP B & W Sterling 115 Psi With Stoker.

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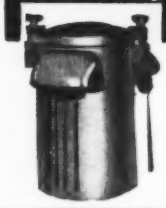

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1—100 KW, 400 RPM Buckeye

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3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	Al. Ch.	1 (2200 V.)	900
2	50	Al. Ch.		900
1	60	G.E.	KT	1800
4	60	G.E.	KT (2200 V.)	1200
1	60	Reliance	AA	900
1	100	G.E.	I-16	450
1	100	G.E.	KT (2200 V.)	900
4	100	G.E.	K (TEFCBB)	1200
1	110	G.E.	KTP	1800
1	120	G.E.	PT	3600
2	125	Cr. Wh.	126Q	450
8	125	Al. Ch.	AR	450
2	150	Al. Ch.		1750
1	250	G.E.	I-17	900
1	250	G.E.	KF (Vert.)	3600

SLIP RING—SYNCHRONOUS

3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

50	Al. Ch.		520
50	Al. Ch.		720
50	Ideal	AV	600
50	G.E.	I	700
60	Ideal	AVX	1200
75	West.	CW	400
75	G.E.	J	520
75	Fair. Morse	BV (2200 V.)	1800
100	G.E.	TRB	600
100	G.E.	I-16 (2200 V.)	450
100	West.	CW (B. P.)	1800

Qu.	HP	Make	Type	Speed
1	100	KW G.E.	ATB (.8 PF)	900
1	125	Fair. Morse	T (2400 V.I.O PF)	900
1	150	G.E.	TS (.8 PF)	1800
1	200	G.E.	TRC (.8 PF)	400

D.C.—230 Volt
(Other voltage as noted)

1	50	West.	SK	850
1	50	G.E.	CD 1341	500/2000
3	50	Reliance	T	2700
1	50	West.	SK (115 V.)	500
1	60	West.	SK (115 V.)	500/1500
1	75	Diehl	K11	700
1	90	Cr. Wh.	CMC	225/550
1	100	West.	SK	850
1	100	Cr. Wh.	CM	600
1	130	Cr. Wh.	CMC (550 V.)	1200
1	150	West.	SK	850
1	180	Cr. Wh.	CMC	450

M-G SETS

1— 45 KW West. 60 V DC—440 V AC 1200 RPM
4— 60 KW G.E. 60 V DC—440 V AC 1200 RPM
3— 75 KW El. Mach. 230 V DC—440 V AC 1200 RPM
2— 75 KW El. Prod. 220 V DC—440 V AC 1200 RPM
1—100 KW Ridge 250/275 V DC—440 V AC 1200 RPM
1—105 KW Century 70 V DC—440 V AC 1200 RPM
1—150 KW G.E. 250/275 V DC—440 V AC 900 RPM

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1—200, 150 & 100 HP Slip Ring Motors
1—242 KVA Generator D.C. Unaflow Engine
1—450 HP B&W Sectional Header WT Boiler

H. & P., 6719 Etzel Ave., St. Louis 14, Mo.

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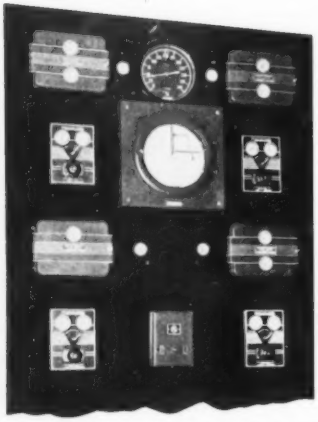

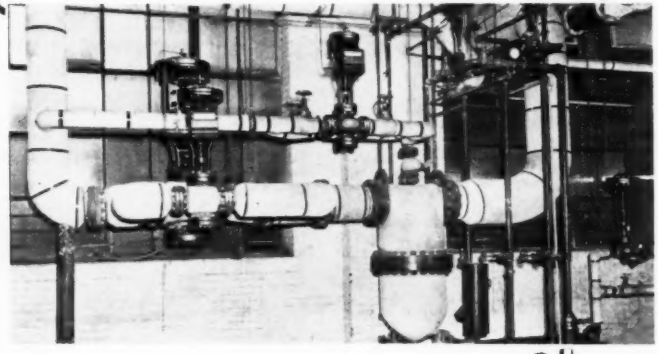

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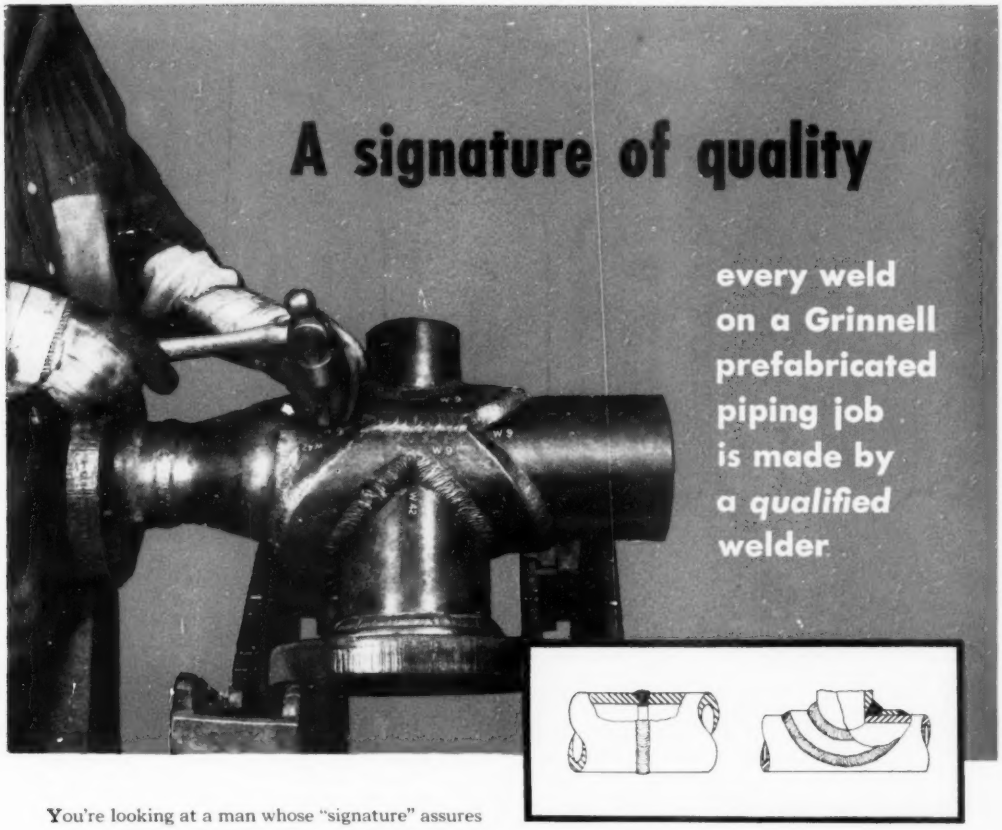

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Characteristics	CONVENTIONAL DESIGN	SLUDGE BLANKET DESIGN
Silica in raw water, as SiO_2, ppm	55	55
Silica in effluent, as SiO_2, ppm	11	2.0
MgO feed, ppm	76	59
Parts SiO_2 removed per part MgO	0.6	1.1
Average retention time of $Mg(OH)_2$ in hours	4.7	100
Contact time of water with $Mg(OH)_2$ in minutes	92	87
Hardness of effluent, as $CaCO_3$, ppm	21	15
Average load on softener, % rated capacity	65	46
Temperature in softener	220°F	243°F

Write for full information to the Permutit Company, Dept. P-10, 330 West 42nd Street, New York, 18, N. Y., or to the Permutit Company of Canada, Ltd., Montreal.

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